BELL TELEPHONE QUARTERLY

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President Walter S. Gifford, of the American Telephone and Telegraph Company, inaugurating telephone service between America and Paris with a conversation with M. Maurice Bokanowski, Minister of Commerce and Industry for France

BELL TELEPHONE QUARTERLY

A MEDIUM OF SUGGESTION
AND A RECORD OF PROGRESS

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Building for Service

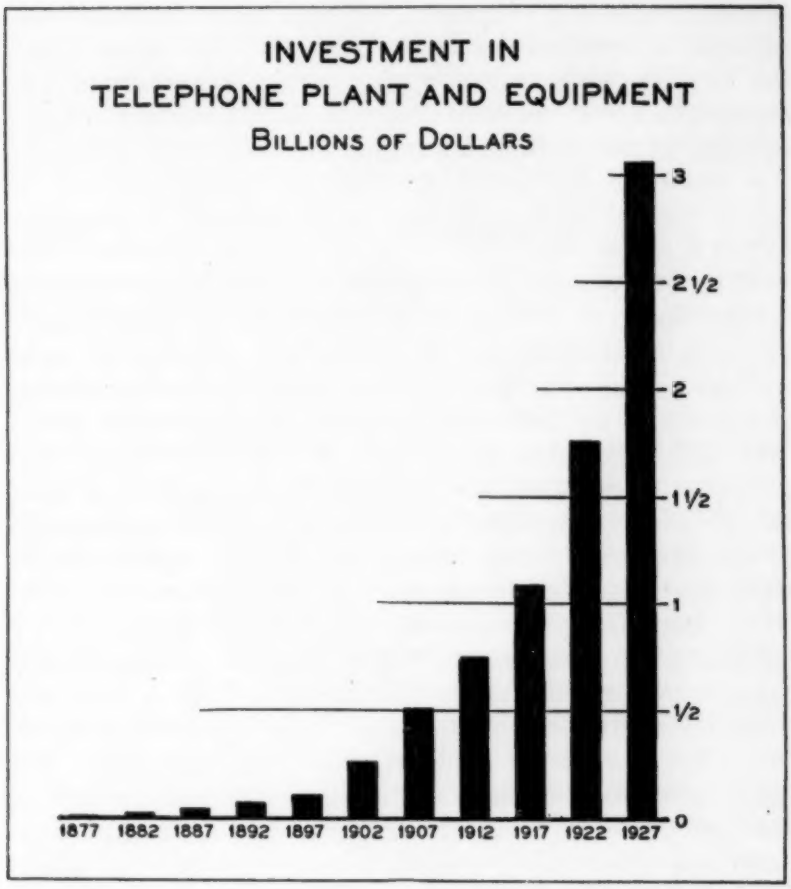
TO furnish the best possible telephone service at the least cost to the public—this is the aim of the Bell System. Devoted to this service—nation-wide in scope, yet truly a community institution—is a plant the amount of which recently reached the enormous total of three billion dollars. This is the plant that stands ready to serve each of the nearly 14,000,000 telephones of the Bell Companies—to connect any one with any other or with the 4,600,000 telephones of the connecting companies, and with Canada, Cuba and Great Britain, and many of the principal cities of Mexico and continental Europe. Building for this service involves not only the provision for those facilities necessary to connect new telephones and to care for the increased telephone conversations now averaging over 55 millions each day, but includes the facilities required to make possible further improvements in the quality, speed and dependability of the service. In the past year alone over one-third of a billion dollars was expended on new plant construction to care for the growth in the business, for improvements in service and for betterments and replacements of plant.

Throughout its history the Bell System has always directed painstaking effort toward improving the service, yet never has the progress been more marked than at the present time. Definite improvement in the accuracy of local service—better handling of the calls requiring special assistance—faster completion of toll calls—reduction in time of installing new telephones—inauguration of transatlantic service—reflect but some of the accomplishments of the past year made possible by betterments and extension in the plant, improved methods of operation and intensive research.

It is of interest to trace the building up and extension of this great plant devoted to the public service and perhaps this can be best visualized by considering its growth in investment. From the facing chart it can be seen that it was not until 1917 or 41 years after the invention of the telephone that the plant investment reached one billion dollars. From that time, however, the investment has accumulated very rapidly, the second billion mark having been reached in 1923, only six years after the first billion, and the third billion in the brief span of a little less than four years or at a continuous rate night and day of over $500 per minute.

This investment which has been built up in only 51 years already represents a hundredth part of the national wealth. It is a significant fact that since the opening of commercial service the Bell System each year has shown a continuous growth both in telephones and plant investment regardless of what the general business conditions have been. This in itself is probably a precedent unequaled in the history of our great American industries and emphasizes the foresight of those who conceived and those who have built and extended this great plant which has been able to meet the phenomenal demands for service which have been and are being experienced while, at the same time, the investment in plant per telephone has been kept low enough so that the cost of the service is within the reach of all.

The first service after the discovery of the new art of telephony was given with simple apparatus over short lines connecting two telephones. It became apparent from the first that if telephone communication was



to become a commercial success, a very comprehensive distributing and switching system would have to be established for effecting interconnection between large numbers of subscribers' lines. There was little in the electrical industries of the time, namely the telegraph and various alarm services, to draw upon in the way of

apparatus, cable and other arrangements required for the establishment of such a system and it became necessary, therefore, to create new equipment and facilities for the purpose; in fact to create a new art. It is interesting to note the great strides that have taken place in the building up of the various component parts of the present system—the switching or central office equipment, the the outside cable and wire plant, the subscribers' apparatus, the land and buildings and the so-called general equipment which includes motor vehicles, tools, etc.

Central Office Equipment

The first central office for interconnecting service was opened in New Haven, Connecticut in 1878—just fifty years ago—and connected eight lines serving 21 subscribers. The switchboard was a simple affair consisting of a series of contact points mounted on a wooden panel over which movable arms could be rotated by an attendant for completing the connections. Beginning with this simple type others followed in quick succession only to be displaced when others of greater capacity and efficiency were developed until switchboards with relatively complex arrangements providing signalling and switching for as many as 10,000 lines in a single board came into general use. The early switching systems were all of the magneto type similar to the systems generally now in use in the smaller communities. As the number of telephones grew and the complexity of the traffic increased in the larger areas, automatic features were gradually introduced into the switching plant. Means were developed whereby the subscriber could automatically signal the operator by simply lifting the receiver. The switchboards in the central offices were improved and by means of little electric lights, controlled automatically by relays, visual signals were given to the operator as to the status of each connection; when the called subscriber answered; whether either subscriber de-

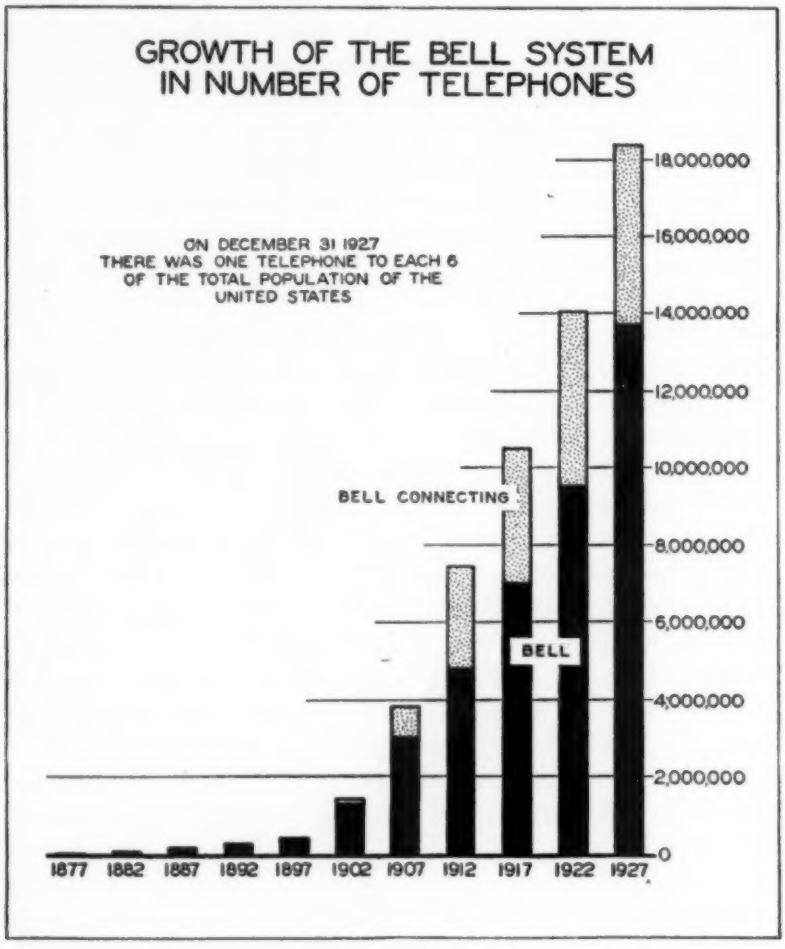
sired attention; when either or both subscribers finished talking and hung up the receiver. Further automatic arrangements were developed and introduced into the plant whenever the speed, efficiency, accuracy and economy in operation could be improved. These automatic arrangements were not only confined to the manually operated switchboards but satisfactory equipment was perfected for establishing local connections entirely by machinery and this type of equipment is now being introduced into the Bell System plant at a rapid rate.

By these developments the telephone engineers not only made possible a dependable plant but one with sufficient flexibility to care for the phenomenal growth experienced especially during the last thirty years when the number of telephones in the Bell Companies grew from 420,000 to a total of close to 14,000,000 as indicated by the chart below.

In addition means were made available for interconnecting these Bell owned stations with some 4,600,000 additional stations owned and operated by connecting companies. Of these Bell owned telephones in the System at the end of 1927, 800,000 were operated from magneto or rural central offices, 10,300,000 from the common battery manual central offices and 2,600,000 from dial offices where all local connections are made almost entirely by machinery without the aid of operators.

The switching centers or central offices in the United States for making the necessary interconnection between subscribers' lines now number over 6,100 and are located everywhere throughout the land. The investment in this switching and terminating equipment alone represents an investment of over ¾ of a billion dollars or an amount equal to the total investment in the Bell System some 15 years ago. It is estimated that during the year 1928 approximately $100,000,000 will be expended for new central office equipment required to provide for growth and extensions of service and to replace existing equipment which has become worn out or inadequate.

The size of the construction job this year can be better visualized from the fact that new central office equipment for growth and replacements will be added for over



1,000,000 telephones, 750,000 of which will be of the dial type.

Outside Plant

In order to connect the 14,000,000 or so telephones to central offices and to provide for connections between

the central offices there is a system consisting of 57,000,000 miles of wire about 92 per cent. of which is in cable and 8 per cent. in open wire. The developments in this part of the plant during the expansion of the telephone service have been as remarkable as those which have led to the extensive switching systems of today. It is natural that at first the overhead single wire ground return circuits similar to those used at the time in the telegraph should have been used for the telephone, but not for long, for it soon became evident that an all metallic or two-wire circuit was necessary in order to minimize interference and noise. Due to the trouble resulting from induction the cables of the type used for the telegraph could not be employed. Consequently the outside plant during the first decade of its growth consisted almost entirely of open wire. The need for replacing this veritable network of poles, crossarms and wires in the large cities arose almost before there was a chance to perfect suitable means, but carefully directed research and development pointed the way to relieve the situation as required. Probably no other single development has yielded such great returns both in the way of increased service and money savings as the development of cables suitable for telephone use. Here again the development of an entirely new art was necessary and many obstacles had to be overcome, but scarcely a year has passed since the early eighties that some improvement has not been made in cable design and method of manufacture. A 50 pair No. 18-gauge cable was first developed and placed in the plant and the cost per mile of circuit in place in that cable would today be close to $150.00. By 1896 a 200 pair No. 19-gauge cable had been perfected with a cost per circuit mile of $50.00 equated to present day prices. The rapidly growing need for cables containing more wires stimulated development work leading to the production of cables with fine wires and 400, 600, 900 and 1,200 pair cables followed in quick succession. With each

successive step costs were further reduced until today the cost per circuit mile in 1,200 pair cable is less then $15.00 or one-tenth that of the cost 35 years ago. From this it can be seen how intensive research and development has brought forth economies to minimize the effect of the increasing costs arising from the added complexity of the plant as the System expands.

The development of cables suitable for long distance lines and the supplementary equipment such as loading coils, repeaters, etc., was likewise carried forward until today conversation can be carried on by cable over several thousand miles as compared with a possible distance of approximately 10 miles 25 years ago.

This great network of outside plant connecting the United States into one great community, represents alone an investment of close to 1½ billion dollars, about one-third of which is for plant necessary for the giving of long distance toll service. A more concise picture of this extensive outside plant may be obtained from this list of the larger items that go to make up the total.

392,000 miles of pole lines	$312,000,000
14,500,000 miles of wire in aerial cable	256,000,000
38,000,000 miles of wire in underground cable	412,000,000
4,500,000 miles of aerial wire	255,000,000
81,000 miles of duct	206,000,000

With a plant of this magnitude not only is it necessary to make additions for growth and expansion but vast amounts of plant must be continually provided to replace that which becomes worn out and inadequate. Thousands of miles of pole lines are rebuilt and strengthened each year in order to keep them in condition to withstand the ravages of the elements. Preventive maintenance is practiced in every branch in order to safeguard the service and investment. The open wire long distance circuits are being replaced with either aerial or underground cables whenever the density of traffic will justify a group of circuits large enough to be economi-

cally housed in a cable. In 1928 the construction program for new outside plant in the Bell Companies is estimated at about $170,000,000. This new construction will care for the growth in the business, for improvements in service and for extensions and replacements. Large amounts of new material will be required as indicated by the fact that arrangements have been made for the purchase and delivery in 1928 of about 1,000,000 poles, 1,100,000 crossarms, 6,500,000 miles of wire in lead covered cables, 35,000,000 pounds of bare copper wire, 10,000,000 pounds of galvanized iron wire and close to 4,000 miles of underground duct.

Station Equipment

The station equipment, or that part of the telephone plant which is located on the subscriber's premises or in pay stations in public places, has also gone through many stages of improvement and development. The effectiveness and serviceability of the transmitters and receivers and all other parts of the station apparatus have been steadily increased.

As the usefulness of the telephone came to be realized, the amount of station equipment that the subscriber found helpful and commensurate with other conveniences began to increase. One of the first steps was from a single telephone to one or more extension telephones on the same line. This was followed by numerous and comprehensive arrangements of lines and stations for connection both with outside telephones and with other telephones on the subscriber's premises. Where a large number of telephones are required by a subscriber switching equipments known as "Private Branch Exchanges" are available, thereby eliminating the necessity of going through the central office except on calls to outside subscribers.

Private branch exchange equipment has shown a remarkable growth in the last twenty years as is indi-

cated by the fact that there are now over 120,000 such boards through which 2,500,000 telephones are connected to the Bell System. These private branch exchange boards, which range in size from a small turret connecting a few telephones to multi-position boards serving between three and four thousand telephones, represent a capital investment of $92,000,000. In 1928 over 15,000 positions of private branch exchange equipment will be placed in service involving a gross construction expenditure of about $22,000,000.

For the convenience of the general public pay station equipment has been developed and made available in hotels, railroad stations, stores and public places. These public telephones form an important link in the nation-wide telephone service, the extent of which can be measured by the fact that the investment in booths and fittings alone is over $15,000,000.

The total investment in station equipment, including private branch exchanges is $390,000,000 and the gross construction expenditures in 1928 for this part of the plant in order to care for growth and station turnover will be almost $100,000,000. Over 1,000,000 new telephone sets, 800,000 desk stands, 350,000 hand telephone sets, and close to 70,000 coin collectors will be required in connection with this construction program.

Land and Buildings and General Equipment

While vast sums of money have been invested in that part of the telephone plant actually used in the interconnection of the subscribers and in the transmission of speech there are other related phases of the business, the magnitude of which is perhaps scarcely realized by the telephone using public. The most important of these related activities have to do with housing, transportation and supplies. With regard to the first item there are close to 6,000 buildings in use in the System a large number of course being company owned. These

buildings range in size from small isolated repeater stations to the huge Metropolitan combination office and equipment buildings covering a whole city block and from 20 to 30 stories in height.

In the early days of the telephone when the number of subscribers was small the housing problem was simple and the switchboards were usually located in rented buildings. With the rapid growth in the number of subscribers and as the switchboards became more complex and expensive, it became desirable to erect company owned buildings specially designed to house this equipment. These buildings are not only designed to care for the initial needs but so planned that they can be expanded to care for future growth without excessive cost or rearrangement. Because of the need for safeguarding the personnel and also to guard the service from interruption, extensive preparations are made in telephone buildings for protection against fire. The most approved fireproof construction and fire-resisting devices are used and in addition the buildings are equipped with very complete fire fighting appliances.

For the most economical outside plant construction the operating buildings are centrally located with respect to the subscribers served, thereby making it necessary to locate many in residential as well as business sections. In the design of all buildings very careful study is given by the architect to the exterior appearance in order that they will be appropriate to the surroundings, be a credit to the community and exemplify the ideals of the Bell System. In addition to the buildings required for housing the central office equipment other buildings such as garages, warehouses, office buildings, shops, etc., are required to meet the needs of the various departments. These company owned properties represent a capital investment in land and buildings of $311,000,000 or an amount equal to about 1¼ times the assessed valuation of the state of Delaware. The great expansion in this part of the Bell System plant is indi-

cated by the fact that in 1928 it is estimated that close to $40,000,000 will be expended for the purchase of new land and the erection of new buildings to provide for the current and future needs of the business.

The investment in so called general equipment amounts to over $54,000,000 of which some $23,000,000 is represented by office furniture and fixtures. 14,000 motor vehicles, the largest individual motor fleet in the world and representing an investment of $18,000,000, is in constant use by the construction and operating forces. $12,000,000 is invested in tools and implements which include the very latest types of labor saving devices such as earth boring machines, pneumatic equipment for drilling rock and pavement, pole derricks and winches for the pulling of cables through underground conduits.

Conclusion

With the net growth in telephones averaging about 700,000 per year and with the efforts further to improve and extend the service in keeping with the increasingly higher standards of living and material comforts which this country enjoys, the investment in Bell System plant will continue to grow. Each new telephone gained not only means an investment for the instruments and for the wire to connect it to a central office, but also adds to the complexity of the plant required to make it possible to connect it with the millions of other telephones now in service. Similarly, many improvements and extensions are of a character that introduce more exacting requirements and all of this tends to a more than proportionate increase in the plant. The Bell System, having accepted its responsibility for a nation-wide telephone service, must continue to meet the demands and as in the past, intensive research and development will no doubt bring forth new and better types of plant and new and improved methods of operation to offset as far as practical the inherent increasing costs as the System expands.

The true test of telephone service accomplishment lies in the speed, accuracy, extent and dependability of the service rendered, and that this may be realized to the fullest possible extent and at the least cost to the public will continue to be the underlying aim in the building of this great telephone plant.

H. P. CHARLESWORTH.

The Dean of Telephone Engineers

Address of Bancroft Gherardi, Vice-President of the American Telephone and Telegraph Company, in Presenting the John Fritz Medal to John J. Carty, During the Winter Convention of the American Institute of Electrical Engineers, New York, February 15, 1928.

IN 1879, only three years after Alexander Graham Bell had first publicly demonstrated his telephone invention, a young man eighteen years of age who had prepared for Harvard, but was prevented from continuing scholastic work by temporary impairment of his eyesight, entered the employ of the Bell Telephone Company in Boston.

It is difficult, if not impossible, for any of us now to visualize the telephone problem of that time and the conditions under which it had to be approached by the telephone pioneers of that day. Much of our scientific knowledge of today had not been discovered; there were no schools of electrical engineering to provide trained personnel; the American Institute of Electrical Engineers was not to be founded until five years later; there were no sources of electrical energy except primary batteries and magneto generators; no adequate theories of the transmission of electric currents over wires; no commercial applications of electricity except the electric telegraph and the infant telephone art. At that time there were in the whole of these United States fewer telephones than are to be found today in East Orange, and it was impossible to talk over distances greater than a few miles.

Practically nothing had been done and few of the essentials to the attainment of our present telephone system were known. But there was a small group of men of vision and of courage, confident of the possibilities of the telephone and determined that it should attain the future

that they saw for it in their dreams. One of these was John J. Carty.

To tell the story of his life and of his contributions is to tell a very large part of the scientific, technical and engineering development of the telephone art, not only in this country but for the whole world. After early experience in the design, construction, maintenance and operation of telephone systems in and around Boston and with the Western Electric Company in New York City, Carty in 1889 became the Chief Engineer of the New York Telephone Company. In that position he was responsible for the technical problems of the city which is telephonically the greatest in the world and where new problems are most likely to arise. In 1907 he became Chief Engineer of the American Telephone & Telegraph Company, the parent company of the Bell System. At the outbreak of the War he was ordered to active duty as a Major in the Signal Corps of the United States Army. He saw active service in France and rapidly rose to the rank of Brigadier General. Since his return from France in 1919 he has been Vice-President of the American Telephone & Telegraph Company. These, briefly, are the positions which he has held. What did he do with the opportunities which they offered?

His personal contributions to the telephone art have been notable. He designed and installed the first multiple switchboard which contained the fundamental features of common battery signaling, and later was the first to show how to operate two or more telephone transmitters from a single source of electric supply. These, together, constitute the foundation of the common battery system of today essential to every large telephone switchboard, whether automatic or manual.

From the start of the telephone business, one of the difficulties which had to be met was to prevent induction between closely adjacent telephone circuits, the result of which would be that speech taking place in any one of the circuits could be overheard in all. Closely related

to this problem has been that of minimizing external inductive disturbances—those that come from electric currents in other than telephone circuits, and from atmospheric or earth currents. At a time when but little was known on these subjects, Carty made an important scientific investigation of their nature and set forth the view that under many conditions these disturbances were electrostatic and not electromagnetic in character. This view was so novel that it was not generally accepted until it had been checked and verified by others, but it was soon recognized as correct and served as a guide to much essential work in the minimizing of these disturbances. This work of Carty's made it possible to give scientific treatment to the twisted-pair and transposition problems and laid the foundation for the keeping of inductive disturbances within limits that permitted the development of the industry.

Early telephone systems followed the usual telegraph practice of placing telephone instruments, including the signaling devices, in series in the line. The result of this arrangement—when there were several instruments on the same line—was to impair telephone transmission seriously and to interfere with satisfactory signaling. It placed severe limitations upon the number of telephones which might be connected to a single line. Carty's scientific study of this question led him to the conclusion that the instruments should be placed in parallel and not in series, and should be re-designed so that the signaling apparatus would have high impedance. This invention is commonly known as "Carty's bridging bell." It removed many of the difficulties which had formerly imposed serious limitations on the development of the business, and made the party line and the rural subscriber's line a possibility.

Carty prepared the plans and immediately directed the work of converting the New York City telephone plant from open wire to cable, and later from the local battery switchboard system to the common battery sys-

tem, at a time when the general development of the art was such that almost every move required invention, development and engineering along new lines.

If we were to take out of the present telephone system those things—a few only of which I have mentioned—which John J. Carty personally devised and contributed to the art, essential elements would have been removed and in many important respects the system would no longer be operative. This is some measure of Carty's individual achievements.

But he had qualities not always found in men of individual creative genius. He had the rare ability to organize progress as well as to contribute to it himself. As the telephone system grew and its problems multiplied in number and complexity, Carty early recognized that the work to be done required the development of a technical organization, and he was first in the telephone operating companies to employ technically-trained college graduates and to devote systematic attention to their training both in a thorough knowledge of the telephone system and in the correct principles of engineering.

No one who has ever worked in close co-operation with Carty for any considerable length of time can forget the frequency with which he asked the question, "What are the facts?" and the emphasis which he laid on it. Or the importance that he attached to studying all possible solutions of a problem and ascertaining which was the best, taking into account all relevant factors, including first cost, annual charges, service, and flexibility and adaptability to growth and expansion.

He recognized the interrelationship in the telephone business of operating methods, design of the plant, and the rate structure which would largely determine the volume and character of the telephones to be served. He had in mind that all of these factors must be considered in their relations one to the other and their relation to the final result if the system was to give the best possible, the most extended, and the cheapest telephone

service. Always was his engineering dominated by this consideration for the final result, not only immediately but for the years ahead.

His methods not only developed telephone systems and service along sound and effective lines, but he has always been a great developer of people. He inspired them to give the best that was in them; he taught them to do better; and was always lenient to their shortcomings, and both constructive and kindly in criticism. His influence on others extended far beyond those working directly for him. All who had contacts with him felt the power of his keen analytical mind, his breadth of vision, his sense of justice, and his kindly disposition.

The nature of Carty's early contributions to the telephone art showed his clear appreciation of the importance of scientific knowledge to the understanding of telephone problems. When he became Chief Engineer of the American Telephone & Telegraph Company in 1907 he was in a position to do so and he immediately consolidated all of the telephone laboratories and experimental work, which up to that time had been scattered both as to location and executive control, into a single organization which is now known as the Bell Telephone Laboratories. He greatly increased the number of scientists engaged upon this work. Of the many fundamental contributions which have resulted from this arrangement, I shall mention but two. He initiated and pushed to a successful conclusion the work necessary to make transcontinental telephony possible. Through its applications, telephone service has been extended to tie together not only every state of our Union, but to bring into the range of telephonic communication Canada, Cuba and Mexico. He likewise inspired and directed the work which resulted in the sending of the first articulate words across the Atlantic Ocean by radio telephony, and continued this work until today the barrier of the Atlantic Ocean has been overcome and commercial telephone service between the old world and the new is a daily fact. Already four nations of the new world

can communicate telephonically with Great Britain and four nations of the Continent of Europe, and it is not too much to believe that through the further extension of these developments all of the principal nations of the world may be brought into communication by the spoken word.

This organization of research and development was not only a service to the telephone art; it was a notable contribution to our present-day American civilization, for the organization of science to lead industrial progress now common in many industries received a tremendous impetus from Carty's work in the organization of the laboratories of the Bell System and in the obvious value of its accomplishments. It is in recognition of Carty's vision and achievements along these lines that he is a trustee of the Carnegie Institution and of the Carnegie Foundation, a trustee of New York University, a member of the National Research Council, and associated with other organizations whose object is the advancement of science and the applying of these advances to the welfare of mankind.

Until 1917 Carty's genius was devoted to the arts of peace. Then our country was plunged into the World War and it became the duty of every American citizen and organization to contribute their all to the successful outcome of the War. Recognizing the importance of communication and Carty's pre-eminent position in relation thereto, our Government which had previously commissioned him a Major in the Reserve Signal Corps of the Army ordered him to active duty. He devoted to the Signal Corps problem that same judgment, skill and knowledge which had produced such outstanding results in civil life, and largely through his efforts the resources of the nation's telephone personnel, laboratories, manufactures and supplies were brought to bear upon the problems of the War and in such a way as not to cripple the communication on the home front which must also continue to function. In June, 1918, he was ordered to France, where

he was one of the principal staff officers of the Chief Signal Officer of the American Expeditionary Forces. After the Armistice he remained in France for a time in charge of the communications of the American Commission to negotiate peace. In recognition of his services in the Army he received from our Government the Distinguished Service Medal and from France the Cross of the Legion of Honor.

General John J. Carty, who comes to us this evening in order that we may bestow upon him a token of the appreciation in which his distinguished achievements are held by his fellow engineers represented by the four national engineering societies, is—

The creator of telephone engineering;

The discoverer or inventor of many essential methods and devices;

The organizer and director for many years of the Bell System technical and engineering work;

The father of the application of scientific research to the telephone art;

The director of the development of transcontinental and transoceanic telephony;

A pioneer in advocating scientific research in industry;

A leader in the application of the development of electrical communication—which he had such an important part in creating—to the national defense in the hour of our country's need;

The dean of telephone engineers.

Ideals of the Engineer

Address of John J. Carty, Vice-President of the American Telephone and Telegraph Company, upon receiving the John Fritz Gold Medal, during the Winter Convention of the American Institute of Electrical Engineers, New York, February 15, 1928.

IN receiving this great honor, I do so with feelings of deep gratitude and not without a sense of humility, for I realize that the brain of the individual has its limits as a storehouse, and that with knowledge continually increasing, any one mind can take in only a small portion of the rapidly accumulating body of engineering information. In these days, intellectual specialization is absolutely necessary, and whatever I have been able to accomplish is the result of specialization and the cooperation of many individuals.

In order to be of use to society, the ideas of the engineer, in every department, in transportation, communication, and architecture, must first be embodied in physical form, and because of this he has achieved such a mastery over material things, that he is regarded as preeminently the exponent of a material age. The great utility and economy resulting from his activities are so sensational as to conceal from view the ideals which form the basis of his creative work.

If seeking the truth and applying the truth to the affairs of man, is a spiritual thing, then the engineer must be absolved from the charge of materialism. He is an advocate for truth. His works must be tried in the inexorable court of Nature, where no errors are committed and no exceptions granted. The work of the engineer is dedicated to the use of mankind, and the pecuniary compensation which he himself obtains is slight compared with the great benefits received by society. He finds inspiration and reward in achievement,

and his real compensation is the good which others derive from what he has done.

Let us consider briefly the ideals of the engineer and the nature of his functions in the light of modern theories of evolution.

We are told that man has come from a lowly origin, and that during ages of time incalculably long he has advanced to his present position at the head of the animal kingdom. It has been supposed that in man himself, this evolutionary process is still at work, and that therefore, in the course of the ages he will evolve into a superlative type, and then perhaps all will go well.

Inasmuch as this evolutionary process in man himself is said to have taken vast periods of time, it is not unreasonable to expect that further ages must elapse before salvation by this form of evolution could be achieved.

Such a view does not afford much comfort, nor does it provide any basis for a practical program to guide us. Even speaking in terms of the life of a nation, such a process is too slow. We must reckon with man as he now is. Our problems must be solved by working upon him and through him, and cannot wait for the arrival of the hypothetical superman. Indeed, it is stated by an eminent authority, that there are no indications that future man will be more perfect in body than the most perfect individuals of the present, or than the most perfect men and women in the days of Phidias and Praxiteles. There seems to be no general agreement as to whether this process in man himself has actually ceased; but I believe it is safe to say, in any event, that it is too slow in its operation to afford a solution of any of the problems that now confront us.

But this is not all that evolution has to offer. For, even if this one pathway should be closed to further great progress during our age, we are assured by that eminent authority, Professor Edwin Grant Conklin,† that there are two others which are open to us.

† "The Direction of Human Evolution"—Edwin Grant Conklin.

The first of these to be considered is one which is pre-eminently under the control of the engineer. Conklin tells us that the evolution of man, the individual, is no longer limited to his body or mind; but by adding to his own powers the forces of nature, man has entered upon a new path of progress. The differentiations of various members of a colony of ants or bees, he tells us, are limited to their bodies and are fixed and irreversible. But in human society, differentiations are no longer confined to the bodies of individuals, but have become as it were extra-corporeal. And by his control over nature, man has taken into his evolution the whole of his environment. Although he is not as strong as the elephant, nor as deft as the spider, nor as swift as the antelope, nor as powerful in the water as the whale, nor in the air as the eagle; yet by his control of the forces of nature outside of his body, he can excel all animals in strength and delicacy of movement, and in speed and power, on land, in water, and in air.

The true object of engineering is not to create machines to which men will be bound by the chains of necessity, or mechanisms to which they will become slaves. The mission of the engineer is to obtain such a mastery in the application of the laws of nature, that man will be liberated, and that the forces of the universe will be employed in his service. According to Conklin, this new path of progress is in all respects the most important which has ever been discovered by organisms, and no one can foresee the end of this process of annexing to our own powers the illimitable forces of the universe.

Concerning the other pathway of evolution, he tells us that progress in intellectual evolution, no less than in physical, lies in the direction of increasing specialization and cooperation. But this progress, he says, is no longer taking place within the individual, but in the specialization and cooperation of many individuals. The intellectual evolution of the individual may have come to an end; but whether or not this is true, it is certain that the intellectual evolution of groups of individuals is only at the

beginning. In social evolution—the evolution of human society—Conklin says a new path of progress has been found, the end of which no one can foresee.

Progress along this pathway, also, is vitally dependent upon the work of the engineer, for the perfection of all forms of communications and transportation is essential in order that this new super-organism, human society, shall achieve its destiny.

Emphasizing the importance of this, Trotter,† another distinguished writer on evolution, tells us that the capacity for free intercommunication between individuals of the species has meant so much in the evolution of man, and will certainly come in the future to mean so incalculably more, that it cannot be regarded as anything less than a master element in the shaping of his destiny.

The use of the spoken word to convey ideas distinguishes man from all other created things. It is the function of the engineer to provide for the extension of the spoken word by means of electrical systems of intercommunication which will serve to connect the nervous system of each unit of society with all of the others, thus providing an indispensable element in the structure of that inconceivably great and powerful organism which it is believed will be the ultimate outcome of the marvelous evolution which society is to undergo.

There is one element, and only one, which stands in the way of the realization of this inspiring vision. That is man himself, for he is the unit or cell out of which the new organism is to be evolved. In the individual animal organism, the units or cells are physically joined to each other; but in the social organism, the units are individuals, not physically joined, but free to move about at will. The connection between these separate and mobile units is accomplished by communications, which convey information, ideas, and impulses from one mind to another. Whether these communications shall be employed in peaceful, constructive cooperation, or whether they shall

† "Instincts of the Herd in Peace and War."—W. Trotter.

be used to engender conflict and confusion, depends upon man himself.

Already, the applications of science to human affairs have far outrun the ability of man to use them wisely. The engineer has provided agencies of incalculable value in time of peace, but they are also endowed with prodigious powers of destruction which can be loosed in time of war. Unless we solve the problem encountered in man himself, the outlook is dark indeed, and it may even be questioned whether our civilization will endure.

Human behavior presents the most important and the most formidable problem of all the ages. Its solution can be achieved only by profound and prolonged researches, which shall bring to bear upon every phase of the subject all of the resources of science.

While, in such a consideration as this, it would be folly to ignore the claims of religion and philosophy, it would be a grave error to conclude that, in order to avoid disaster, we must restrict progress in the application of science to material things. On the contrary, we must accelerate progress in all the sciences, for the knowledge thus gained will be required in preparing the individual man to function as a sane and peaceful unit in the ultimate social organism.

Scientific research in our universities and elsewhere, conducted solely for the increase of knowledge, should receive more adequate financial support, so that it may be prosecuted with ever-increasing vigor. If this is done, I believe that in the fulness of time, by further scientific discoveries, the physical development of man will be improved, that many diseases will be entirely eliminated, and that immunity to the others will be achieved, and that feeble-bodiedness and feeble-mindedness will disappear. Thus will be removed some of the greatest barriers to social progress.

In the great plan of evolution, the part assigned to the engineer calls for the highest exercise of his creative faculties, for he is to direct the evolution of man's extra-

corporeal powers, providing him with more numerous and still more powerful additions to his feeble bodily equipment.

The ideals of the engineer will not be realized until man has achieved his destiny in that social organism which is foreshadowed "with its million-minded knowledge and power, to which no barrier will be insurmountable, no gulf impassable, and no task too great."

Answering the Question, "Number Please?"

"NUMBER Please?" This question has been asked of all telephone users so many times that it has become a fixed habit either to be prepared to give the operator the telephone number of the person with whom you wish to speak or to ask for "Information" in order to obtain that number. Probably few have paused to ask the question, "Why does the telephone company give each subscriber a telephone number?" or "Why is it necessary for the operator to know the number of the person I am calling instead of just his name?"

Why Telephone Numbers Are Used

If there were but two people, Mr. Brown and Mr. Smith who had a telephone it would only be necessary for Mr. Brown to turn a crank or push a button when he wished Mr. Smith at the other end of the line to answer his telephone. Should there, however, be 50 or 100 people with telephone service it would be necessary for all of these telephones to be connected with some central switching point with some one in constant attendance at this central point who would, on request, connect Mr. Brown with Mr. Smith's line when he wished to talk with him. In such a case the operator at the central office would probably be able to remember the arrangement of the lines on the switchboard in front of her and it might still be possible for Mr. Brown to have his call completed by merely asking the operator for Mr. Smith.

Such a simple telephone system has, however, long since become a thing of the past. The subscribers to telephone service, represented by the original Mr. Brown and Mr. Smith, have now increased to the point where there are over 18,000,000 telephones connected in the

Bell System and these are operated from over 6,000 central offices. Mr. Brown can talk to any one of these telephones and his central office operator may be required to connect him with any one of as many as 10,000 subscribers' lines which appear on the switchboard in that office. Very early in the history of the telephone, due to the rapid growth in the number of subscribers, it became impossible for the operators at the central offices to remember the location of a particular subscriber's line, if calls were placed by name. In seeking a solution to the matter, the most practical solution was to assign to each telephone an identifying number for calling purposes which permitted of a permanent arrangement of the subscribers' lines on the switchboards in numerical sequence and made it possible for the operator to quickly locate the subscriber's line desired. No other more effective scheme has as yet been devised which offers any advantages over this plan or which will not introduce delay in handling telephone calls. Furthermore, the plan of placing calls by number was accepted as a fundamental necessity in the development of the dial telephone system.

How Telephone Number Information is Furnished

Granting the need for placing telephone calls by number the question next arises as to how best to furnish Mr. Brown with the telephone numbers of other telephone subscribers with whom he may wish to communicate so that he may answer the operator's question, "Number Please?" This might be done by having Mr. Brown call "Information" each time he wished to place a telephone call in order to obtain the desired number. Consider the delay this would cause in handling each of the 55,000,000 telephone calls which are completed daily throughout the Bell System. Obviously, such slow service would be most unsatisfactory to every telephone user.

Probably under such a plan each subscriber would prepare a list of numbers frequently called for his own use or place many of his calls from memory. In placing calls from memory, the subscriber frequently transposes the figures of the telephone number or gives the incorrect number which results either in inability to complete the call or the completion of the call to the wrong person, both of which cause delay and annoyance.

Another way of providing number information would be for the telephone company to prepare for Mr. Brown a special list containing the names and telephone numbers of people whom he is in the habit of calling. But Mr. Brown is constantly making new acquaintances and forming new business contacts so that a list of telephone numbers that would meet his requirements today, might be inadequate for his needs to-morrow. Assuming that each of the millions of subscribers was provided with a special list of names and telephone numbers for his own personal use, it would still be necessary to have each subscriber call "Information" in order to obtain the telephone numbers of subscribers not included on his particular list or to be advised of changes in telephone numbers already appearing thereon, which again would involve delay and annoyance to the subscribers or result in many incorrect numbers being given to the operator.

In the interest of satisfactory service, experience has demonstrated that the most practicable method of furnishing subscribers with the telephone numbers of other subscribers with whom they may wish to communicate is to provide all subscribers in a given community with a list in the form of a printed telephone directory which includes the telephone number requirements of the bulk of the subscribers in that community. The service rendered by this printed directory is supplemented by the establishment of "Information Bureaus" where trained operators are constantly in attendance in order to furnish telephone number information to subscribers who may not have a telephone directory at hand or whose local

directory may not contain the information desired. When a subscriber calls the old number of another subscriber whose number has been changed, he is connected with a "Changed Number" operator who assists him in completing his call.

Inasmuch as orders are constantly being received providing for new listings and discontinuing or changing existing listings, the directory itself is to a certain extent, inaccurate when it is placed in the hands of the public. This inaccuracy or obsolescence increases throughout the life of the directory and information operators' reference lists are kept currently corrected so that a subscriber, through the medium of the supplemental directory service rendered by information operators, may promptly obtain the correct telephone number of any subscriber whom he wishes to call.

The printed directory is designed to meet the telephone number requirements of the bulk of the subscribers in the locality in which it is distributed. Too much information in the printed directory results, from the standpoint of the individual subscriber, in inconvenience due to the bulk of the information contained in the directory for which he may have no use. Too little information on the other hand also results in inconvenience to the individual subscriber due to the excessive number of calls to "Information" which he is required to make in order to satisfy his telephone number needs. Frequently, in order to meet the needs of the bulk of the subscribers in a given locality, it has become necessary to provide all subscribers with large books and in some cities more than one volume is required.

Handling Changes in the Telephone Directory

In order to give a picture of the problems involved in preparing a printed directory which will be most serviceable to the user it may be helpful to lead the reader behind the scenes in order that he may observe some of the procedures involved.

Let us assume that Mr. Brown enters a business office of the local telephone company and requests the installation of telephone service. An application card is first prepared on which, in addition to other information, is recorded Mr. Brown's name, business, and address, as they will appear in the directory and this information is submitted to him for approval before he leaves the business office.

With this application card as a basis, a sufficient number of copies of a "service order" are written to satisfy the needs of the various departments of the company. One copy must go to the workman who is to install the instrument at Mr. Brown's office, another to the workman in the central office who will make the necessary connections at the switchboard, and still other copies to the information operators, accounting department.

One copy is forwarded to the directory department where a group of specially trained girls separate those orders calling for work which in no way affects the directory listings, such as orders for additional extension stations, from those orders which require some alteration in the existing directory listings, the insertion of a new listing, or the removal of a listing already appearing in the book. These orders are then passed to girls expert in the alphabeting of directory listings who arrange them in the proper sequence.

In determining the proper sequence of directory listings, a set of alphabeting rules has been developed with a view to rendering the greatest possible service to the user of the directory. In many cases, due to the fact that a number of subscribers will have the same surname and frequently the same given name and initial, it is necessary to take into consideration the business designation, and occasionally to consider address in determining the proper sequence of the listing. The girls whose responsibility it is to arrange in alphabetical sequence the thousands of orders affecting the directory

which are received from the various business offices must be thoroughly familiar with all of these rules in order that their work may be done accurately and rapidly.

After the orders have been arranged in proper sequence, they are passed to other girls who are specially trained in the preparation of what is termed, "printers' copy." The "printers' copy" consists of sheets of paper on each of which is printed one column of the listings appearing in the current issue of the directory; cancelled listings are ruled out, new listings entered, and necessary changes made in the listings which are to be altered.

Due to the constant increase in the number of telephone subscribers and the changes being made by existing subscribers which affect the name, business designation, address, or telephone number of the listing appearing in the directory, a total of over 10,000,000 new, discontinued and altered listings are handled each year in the Bell System directories. Each one of these changes required the issuance of at least one service order for the directory compilation forces in preparing the "printers' copy."

Information Service

Furthermore, every order affecting a directory listing which is received during the period between the issues of the directory must be specially tabulated on visible card files placed before the information operators or printed in regular directory page form and furnished to the information operators as an "addendum" to the current directory. All of the listing changes which take place during the day are printed in this "addendum" form at night and delivered to the information operators the following morning in order that they may, at all times, be able to furnish currently correct telephone number information to subscribers desiring it. In the larger cities, this "addendum," during the six months period that the directory is in service, becomes a large directory in itself, frequently containing more than 400

pages. The telephone using public calls the information operator over 1,000,000 times a day and it requires over 3,000 specially trained operators to furnish this important phase of telephone number serivce.

Printing the Telephone Directory

At the close of the directory period, the "printers' copy" is forwarded to the printer and from it slugs are cast on Linotype machines. These slugs contain one line of listing matter the width of a column in the directory and are accumulated in trays. These trays of new listing slugs are later taken to large "galley" trays which contain the slugs from which several columns of listings appearing in the current directory were printed. The cancelled or changed slugs are removed from the "galley" trays and the slugs for new or altered listings are inserted in their proper alphabetical order.

It is then necessary to take the slugs from the "galley" trays and make them up into page formation and from these page "lock ups," copper electroplates are made. From 8 to 72 of these electroplates are placed on the press at one time, depending upon the size of the press and in the case of the larger presses, "signatures" of 72 pages each are printed and delivered in folded form by the press at the rate of 7,000 "signatures" an hour. These "signatures" are then assembled in the proper sequence and passed to the binding machines where the covers are attached. The books are then trimmed, bundled and shipped to the distribution point.

Thus, the handling of a single new listing in the printed directory has involved seven different procedures, safeguarded by five checks in the offices of the Telephone Company and has passed through eleven separate operations with four additional checks in the printing plant before the finished directory is ready for delivery to the subscribers.

The magnitude of these operations can readily be appreciated when it is realized that the Associated Bell

Companies publish over 1,900 different directories, most of which are issued twice a year, totaling over 31,000,000 individual directories annually.

Constant attention is being given to the page arrangement of the directory with a view to so arranging the listings and indexing the pages as to provide the greatest ease of reference in locating the desired listing and telephone number as rapidly as possible. Studies have been made of type faces which might be suitable for directory printing and, as a result, complete new type faces have been designed solely for the use in telephone directories. Special printing plant machinery and manufacturing technique have been developed and telephone directories constitute the principal output of several of the largest printing plants in the country.

In the printing of the telephone directory, much care has to be taken with the quality of the paper used in order that the book will withstand a normal usage during its life. Special formulae have been developed for the manufacturing of directory paper and frequent laboratory tests are made by experts thoroughly familiar with the technique of directory paper manufacture and constantly in touch with the paper mills, in order to maintain the quality and degree of whiteness in the paper which will permit of satisfactory printing results, present a directory of good appearance and withstand normal usage. Annually, over 1,000 such tests are made which include daily samples from each paper-making machine in each of the mills furnishing paper for the Bell System directories.

All of the operations incident to the publication of the telephone directory are constantly being studied with a view to developing the most efficient and accurate methods. It is recognized that, from the standpoint of the individual whose listing is incorrectly printed in the directory, it matters little that all other listings in the book are correct. Therefore, constant attention is being given to improving the accuracy results.

Delivering the Telephone Directory

Leaving the finished directory in the printing plant ready for shipment to the point of local distribution by freight cars or motor trucks, we must now turn back for a moment to the office in the Telephone Company where the forces of girls are sorting orders, preparing "printers' copy," or preparing records for the use of the information operators. Here we find a special force of girls taking these same orders and preparing records of all subscribers which are arranged geographically by street numbers to be used as a basis for delivering the finished directory to each subscriber. These delivery records are arranged by routes, special forces of delivery men are recruited and instructed in the delivery procedure, the books are received from the printing plant at centrally located distribution points and delivered by men, equipped with push carts, bags, or other means of carrying the books, to be delivered and the old books which they collect. Of course, in the case of certain of the smaller directories, such a comprehensive delivery plan is not required as these books can be mailed to each subscriber and in certain of the smaller towns, Boy Scouts deliver the books to the subscribers. An effort is made to complete the delivery of the directory to each subscriber in as short a time as practicable. Records are kept of those subscribers who are not at home or who may have moved in the short time which has elapsed since the final check of the delivery records, in order that these cases may be followed up and a special delivery of the directory made. In order to make sure that no subscriber has been skipped in the delivery, newspaper or other publicity is given to the fact that the delivery has been made in order that any subscriber who has not received his copy of the new issue may notify the telephone company.

Additional Number Information Service

Although we have completed a rather hurried trip behind the scenes and observed some of the work involved in preparing directory information for the printer, followed the procedures necessary in the printing plant, and viewed some of the activities necessary in order to furnish the information operators with the necessary information, we have not, as yet, finished with a complete review of what is involved in furnishing telephone number information. There is, in every locality, a large number of subscribers who have need for more directory information than that which is contained in their local directory because of their wider telephone contacts through the medium of toll service. In order to meet the ever increasing needs of this body of subscribers, it is necessary that directories for other cities be made available and furnished to those subscribers who have need of them and, particularly in the large cities, directory libraries containing directories of principal cities throughout the System have been established for the use of the public. In an ever increasing number of cases, special lists of numbers frequently called are being compiled and maintained for the use of subscribers who have need for out-of-town numbers. Directories of all principal cities are made promptly available to the toll information operators for their use in furnishing numbers to calling parties or supplying numbers in connection with toll calls placed without number.

Maintaining Directories in Usable Condition

Directories at public stations and at many subscribers' stations receive very heavy usage which requires frequent replacement of these directories. At certain of the public stations, particularly those located in large railroad terminals, new directories are placed in service each morning and observations have developed the fact that even with this frequent replacement, many

of the directories are badly worn or mutilated before night.

In addition to the ordinary wear and tear of directories due to heavy usage it has been observed at certain public stations, that people referring to the directory will often remove all or a portion of a page without giving thought to those following them, which also increases the requirements for directory replacements. In many cities, the directories placed at public stations are now bound with stiff covers which has resulted in improving the appearance and prolonging the useful life of the directory.

Examination of old books collected each issue in the larger cities are made in order to determine the wearing qualities of the paper and the binding of the directory and the durability of other manufacturing processes with a view to furnishing more serviceable directories as well as determining locations where replacements should be made during the life of the directory.

Street Address and Classified Directories

The fact that the telephone companies have available the name, business, address and telephone number of every subscriber places them in the position of furnishing the public with certain information which is not elsewhere available. It has been found that certain subscribers have need for a directory which will contain the listings of subscribers arranged by street address with the result that in some cities what are termed "Street Address Directories" are now being published and leased to subscribers who have need for them.

Additional telephone number service is provided by the classified business telephone directories which are published in over six hundred cities in the Bell System. These directories contain the listings of business subscribers arranged alphabetically under headings descriptive of businesses or commodities sold. These directories

render a definite service when a subscriber wishes to find the telephone number of a person in a particular line of business or who deals in a given commodity. They are also helpful when one wishes to make a business contact with some one of a number of subscribers in a particular line of business.

Using Correct Telephone Number Improves Service

Mr. Brown's telephone would be of little service to him unless it were possible for him to be connected with any other subscriber with whom he might wish to talk. Likewise, the adequacy and promptness of the service which the telephone companies are endeavoring to render Mr. Brown is seriously restricted if he does not make use of the various means available for ascertaining the correct telephone number of any person with whom he may wish to talk. Telephone calls placed from memory frequently result in incorrect numbers being given to the operator causing service delays to the person making the call. Calls placed without number also result in delays due to the fact that the directory operator must first locate the number before the call can be completed.

From time to time suggestions are received from subscribers with respect to possible improvements in the directory service. These suggestions receive careful consideration and are helpful in developing plans for rendering telephone number service.

More and more subscribers are keeping the telephone directories convenient to the telephone, referring to them when making telephone calls, making use of information service and the other means available for obtaining telephone number information. These are good telephone habits which will well repay the subscriber by increasing the usefulness, convenience, and promptness of his telephone service.

O. C. Lyon.

Measures of Regional Business Activity

AN article in the October, 1924, issue of this QUARTERLY discussed "The Statistical Study of General Business Conditions," and set forth briefly the purposes and value of such study. The general business curve constructed by the Chief Statistician's Division of the American Telephone and Telegraph Company was reproduced as a typical measure of short-term fluctuations in business activity for the country as a whole. With this curve were compared certain others representing production, transportation, trade and prices. Some of these others showed fluctuations which conformed with those of the general business curve. Others did not. These examples served to illustrate the necessity for the selection of the significant data in studying and interpreting general business conditions for the country as a whole. The article concluded that the economic work of the American Company in this field, which had been largely concerned with nation-wide business conditions, "should now gradually be supplemented by an increasing amount of similar work on the part of Associated Companies, covering conditions in their respective territories." Since that time a considerable amount of progress has been made in the statistical study of regional business conditions, and it is the aim of the present paper merely to discuss some of the results of this work, with only incidental reference to the matter of the direct application of these results to the telephone business.

BACKGROUND OF THE WORK

It is obvious that there may be material differences between the economic conditions, tendencies and forces which exist in the country as a whole at any given time and those which exist in any one section. Those variations are due to differences in certain elemental factors which are in reality the foundation of the business and

economic structure, such as the character of the people, geographical location with its influence upon productive or trading activities, existence or absence of workable natural resources, and the types of those resources which are present, and the efficiency of transportation facilities in bringing producer and consumer together. One would hardly expect to find the same influences at work from a general business point of view in a small, highly industrialized, agricultural-deficit state, with relatively few natural resources, such as Connecticut, and in a great territorial empire comprising approximately one-fifth of the area of the United States, such as that in which the Southwestern Bell Telephone Company operates, and which includes such varied fields of activity as oil production, lead and zinc mining and reduction, agriculture, stock-raising, and manufacturing, all to an important degree. Neither would one expect to find the same types or series of data of equal value in the interpretation of conditions in territories differing so widely.

As was brought out in the October, 1924, article, the telephone business, while of an unusually stable character, is to some degree at least affected by changes in economic conditions and fluctuations in industrial activity as exemplified by the cyclical movements of a general business index. The American Telephone and Telegraph Company's index of general business, referred to above and shown in all the charts of the present article, has proved useful in appraising the effect of fluctuations in general business on the current operations of the Bell System and in furnishing economic background for estimates of future operations. In view of the fact that general business conditions vary in different sections of the country at any given time, it seemed logical to construct regional business indices for Bell System Operating Company territories as well as for the entire country. Four of those curves, representing business conditions in sections of the country with widely differing economic interests, will be used as illustrations in this article.

Of first importance in the construction of any general business index is the limitation of the field to one of the broader classifications of business indicators. As a concrete example, the American Company's curve is principally an index of fluctuations in the volume of productive activity in certain basic industries. It does not pretend, on the one hand, to be a comprehensive sample or index of all types of economic activity, from agriculture to retail trade, nor, on the other hand, does it pretend to be a forecasting curve. The problem of constructing regional indices of business activity suitable to the purpose at hand was somewhat different from that involved in constructing the index for the country as a whole. In the first place, there is a much smaller volume of regional than of national data available, and consequently a narrower base for a good sampling job in selecting the significant data. In the second place, even where similar data are available for the local territory and for the country, the regional data may afford less of a clue to business conditions in the local territory than do the data for the entire country to national conditions. Pig iron production for the United States, for example, has a significance in the study of national conditions quite different from pig iron production in the territory of the Mountain States Telephone and Telegraph Company in the study of conditions there. Obvious reasons for this will suggest themselves; among them, the fact that the United States is a self-contained and highly integrated economic unit in the iron and steel industry, while the Mountain States territory is not, and the fact that various economic forces impinging on the Mountain States territory would be reflected in quite a different way and to quite a different degree in that territory's iron and steel industry than would those forces operating in the country as a whole. Again, it often happens that while regional data are available, the geographical limits of an Associated Company's territory may be quite different from those of the area covered by the regional data. Finally,

it has been deemed impracticable in the case of those Associated Companies operating in territories where agriculture is of considerable importance to construct a regional business curve based solely on industrial activity and not taking into account fluctuations in agricultural earnings or purchasing power.

Most of the regional business indices, as a result of the foregoing, are statistically and economically rather less homogeneous than the American Company's index for the country as a whole. But in every case an effort has been made to construct an index whose fluctuations would be such as to give to the management of the local operating company the most accurate and useful possible picture of business conditions in its territory, to assist in the interpretation of current telephone results and in the estimation of future results.

New England and Michigan Indices

There is one instance of a geographical section of the country so highly industrialized, so similar to the entire country in its reaction to general economic influences, that the composition of its general business index is quite similar in character to that of the nation-wide business index. The regional business curve in this case also fluctuates rather closely in harmony with that for the United States. This section is New England. Comparison of the indices for the territory of the New England Telephone and Telegraph Company and for the United States is shown on Chart 1. About ten series of data are included in the New England curve. In the case of all the regional curves, as with the curve for the country as a whole, certain general series are included,—series which do not represent volumes of activities in single industries like pig iron production, but rather the combined results of operations in many industries. Such for example are series of net ton miles on railroads, railroad car loadings, electric power production, and bank clearings (or bank debits). In the New England index,

such data represent in varying degrees a cross-section of practically all industrial activity in the territory covered, and thus supplement the statistics available for certain of the more important key industries of the territory. For the New England territory, net ton miles of freight and freight car loadings on the principal New England railroads, electric power production by public utility power plants in the territory of the New England Telephone and Telegraph Company, and bank debits reported for the principal cities in the territory were used.

CHART 1

In addition, the great textile industry of New England was represented by three statistical series in the cotton and wool industries. For three other important New England industries, namely, boots and shoes, paper, and metal products, adequate regional statistics were not available. The importance of these industries, however, was such as to demand recognition in an index representative of productive activity in basic industries. It was

therefore necessary to incorporate in the New England index three series representing statistics for the country as a whole, and this was done.

A glance at Chart 1 will show that, in general, fluctuations of business activity in the New England territory about a normal or computed trend line have been rather similar to those in the United States as a whole, so far as the latter is reflected by the open line on the chart; though there have been some significant differences,—differences which justify the availability of a separate index for the territory. These differences probably primarily reflect the much greater relative importance of the textile industries in New England than in the United States. It is this, for example, which was principally responsible for the New England curve turning up much earlier in 1921 than did the national curve. And the same influence was potent in keeping the New England index below the other during most of 1925, all of 1926, and the first part of 1927, and then in sustaining the New England index above the other during the latter part of 1927.

The textile industry in New England, important as it is in the economy of that territory, is by no means as dominant therein as is the automobile industry in Michigan. The State of Michigan, while it is highly industrialized, ranking fifth among the states as to value of product added by manufacture in 1925, is more nearly dominated in its business activity by a single industry—automobile manufacturing—and by a single city—Detroit—than is any other industrially important state of the Union. The Michigan Bell Telephone Company operates solely in that state and about one-half of its property is located in the Detroit metropolitan area, which also naturally furnishes a similar portion of the company's traffic. Here was a problem, then, of constructing a general business index for a single state and for a state of unusual economic characteristics. Because of the importance of the Detroit area and the automobile industry, it was

decided to go even further and construct a business index virtually for Detroit. On Chart 2 are shown the Michigan index and the Detroit index as well as the index for the whole country; the Michigan index being a composite of the Detroit index and certain other series of data, while

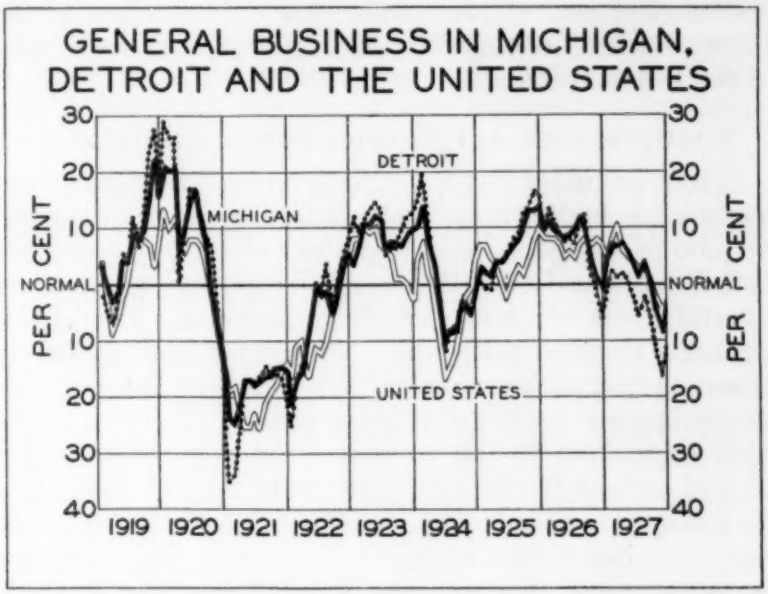


CHART 2

the Detroit index is itself a composite of about seven series. Here again certain general series were used, including such data as railroad ton miles and car loadings figures, electric power production, bank debits in Detroit and in certain other important cities, and Detroit employment figures as reported by the Employers' Association of that city. To these were added, of course, series representing the great automobile industry and, as in the case of New England, several series were used that were not based on Michigan output. These were lumber production for the country as a whole and pig iron production in certain Middle Western districts.

Chart 2, like Chart 1, shows quite a degree of similarity between the United States and the regional curves. It also shows significant differences. The influence of the automobile industry on the Michigan and Detroit curves is clearly evident in such periods as the second quarter of 1923, the first quarter of 1924, the second half of 1925 and the last year shown on the chart. The effect of the Ford stoppage in 1927 is especially evident in the case of the Detroit index.

Northwestern and Southwestern Territories

From an index for a single state and from one representing a highly industrialized section of the country, we pass to the index for the territory of the Northwestern Bell Telephone Company, which covers five great West Central states which are largely agricultural. Obviously, a general business index which represented only or mainly urban industrial activity in that territory would give an inadequate basis for judging general business conditions in relation to the telephone industry. Even such general indices as railroad statistics of net ton miles and car loadings are less satisfactory here than in many other regions because the railroads traversing this territory receive much of their business from outside the territory and carry across these states much freight which neither originates nor completes its journey within the territory. Due recognition in the index of the importance of agricultural activity and agricultural conditions was sought to be accomplished in three ways. The first was through the inclusion of such general series as bank debits and the railroad series; the second was through such series as flour production in four cities of the Northwestern territory and slaughterings of cattle, calves and hogs in certain markets in the same territory. These series, to be sure, emphasize the volume factor of agricultural activity rather than the income of farmers or stock raisers. Incidentally, they also represent industrial activity in the territory. Thirdly, through series representing the

value of marketings of hogs, wheat and corn, it was sought to give recognition to this factor of income. It needs no argument to establish the fact that the prosperity and buying power of the agricultural classes are a function quite as much of the price they receive for their products as of the volume of those products which have been marketed. Furthermore, it is obvious that in the case of an index which seeks to present a monthly picture of fluctuations in business conditions, some series must be introduced which will take cognizance of month-by-month marketings of produce.

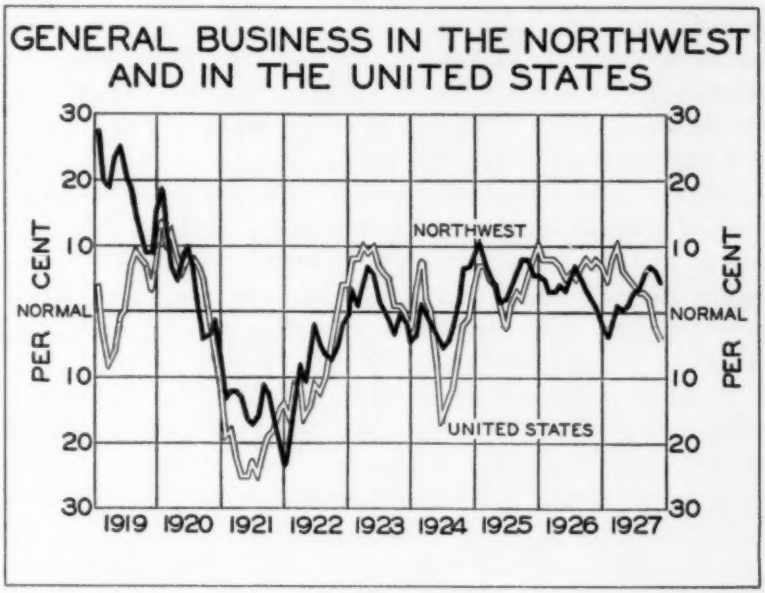


CHART 3

It is clear that we have here an element introduced into the business index with which nothing in the New England or Michigan indices is comparable, and which takes the index out of the class of a homogeneous indicator of business activity. It is also clear that exact economic deductions from such an index are less feasible than in the case of an index based on industrial activity. It

cannot be contended that marketings in any one month result in farmers' purchases in the same month, or that over a period of a crop year, let us say, business activity in a territory will fluctuate at all precisely with the month-by-month income of farmers during that year, even if absolute accuracy of computation of such income were possible. Nevertheless experience with the index has seemed to show that the general picture it gives is reasonably reliable and trustworthy. The index is reproduced on Chart 3. The sharp and almost continuous descent of the index from the beginning of 1919 all through 1921 seems to reflect well that serious post-armistice agricultural deflation with which all are familiar. The failure of the curve thereafter to rise for more than a few months above the curve for the country as a whole until the second half of 1924 again seems to be a fair picture; and the course of the curve since that time, showing, especially in the last year and a half, notable differences from the nation-wide curve, probably gives a fair composite picture of a territory in which there have been highly mixed economic conditions as between wheat growers, corn farmers, hog and cattle raisers, and other elements of the population.

Similar problems were met in the construction of the general business index for the territory of the Southwestern Bell Telephone Company, and it was sought to solve them along somewhat similar lines. Again, such general indices as bank debits, electric power production and railroad statistics were used. The oil, lumber, coal, zinc and lead industries were recognized by the inclusion of appropriate components in the curve. The various branches of agriculture and stock raising are represented by indices of the value of marketings of cattle, hogs, sheep, wheat, corn and cotton. On Chart 4 the curve for the Southwestern territory differs clearly from that for the United States. The depression culminating in 1921 was, as in the case of the Northwest, not only severe, but prolonged beyond the time when business for

the country as a whole turned up. Since that time fluctuations in the curve have synchronized somewhat better with those of the United States curve than in the

case of the Northwest, partly because the industrial element in the Southwest is more important than in the Northwest. The great winter wheat crop of 1926 is definitely reflected in the Southwestern curve during the second half of that year. In 1927 various factors, such as high cattle prices, the large cotton crop of 1926-27, and record oil production have helped to keep the curve from declining as did the United States curve, which reflected the industrial recession of last year.

Summary

The foregoing statement and the accompanying charts have been presented by way of illustrating in a general and non-technical way some of the types of problems met in constructing regional business indices to measure fluctuations in business activity in the territories

of the Associated Companies of the Bell System. The work of making these indices was undertaken because it was realized that no index of business activity for the country as a whole could serve equally well as an index of conditions in various parts of the country, and frequently would be entirely misleading. A large cotton crop selling at a low price might have quite a different effect on conditions in the territory of the Southern Bell Telephone and Telegraph Company from that which it would have in New England; and the effect in New England would probably be much greater than in the country as a whole. The neighboring territories of the Northwestern and Southwestern Bell Telephone companies might be affected in opposite directions by a large spring wheat crop in the Northwest and a small winter wheat crop in the Southwest, while for the country as a whole the net effect would be negligible. In the American Telephone and Telegraph Company's index of general business for the country as a whole, there is no series representing the oil industry, chiefly because that industry pursues the uneven tenor of its way almost entirely regardless of general business conditions and certainly not ordinarily reflecting primarily these conditions in the volume of its operations. Yet a business index for the territory of the Southwestern Bell Telephone Company which took no cognizance of the oil industry in that territory could hardly be considered adequate. Such considerations as these have prompted the construction of the regional business indices.

None of the indices is or can be perfect and practically all of them have already been revised to a minor or major extent. The smaller the territory, other things being equal, the more difficult has been the task of constructing a suitable index. The greater the dominance of the agricultural industry, the more ingenuity it has taken to construct an index which would probably faithfully reflect the fluctuations of business activity or business conditions about an assumed "normal." Refer-

ence to the charts will show that ordinarily regional curves do not run along as smoothly as the curve for the whole country; they present a rather more jagged appearance. The principal reasons for this are probably at least two in number: the mere fact of the mass or volume of operations represented in each of the series in the national curve probably tends to make that curve complete its upward and downward movements with relatively few minor interruptions; and the fact that the regional curves are less homogeneous than the national curve also probably tends to make them less smooth.

Regardless, however, of such imperfections as they may possess, in common with all other composite statistical measures of business activity, it is believed that these regional business indices, *properly interpreted and utilized*, have been and will continue to be of real value both to the Associated Companies and to the American Company, in the same three ways in which the general business index for the country as a whole has been of value; namely, as a quantitative indicator of what business has been doing in the recent past and where it stands at present, as an aid to measuring the influence of outside conditions on the telephone business, and as a background for forecasting.

ROGER M. EASTMAN.

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The Lockwood Papers in the American Telephone Historical Collection

FOR more than 47 years Thomas D. Lockwood was an outstanding figure in the Telephone world. He rose to be General Patent Attorney of the American Telephone and Telegraph Company in 1912 and Consulting Patent Attorney in 1917. He retired in 1919 and died April 5, 1927.

All of Mr. Lockwood's papers having anything to do with the development of the Telephone or with his relations to it have been given to the American Telephone Historical Collection by Mrs. Lockwood and by his son, Arthur G. F. Lockwood. These papers make a large and important accession to the Historical Collection, comparable to the papers of Thomas A. Watson, Thomas Sanders, John Ponton, Thomas E. Cornish, George C. Maynard, (about half his papers), Elisha Gray, J. J. Storrow, E. A. Gurnee, and A. S. Campbell. It will take some time to determine what the Lockwood papers include. As everyone knows, Mr. Lockwood was exceptionally orderly and methodical, but his system was his own, and his remarkable memory, in which he took no little pride, was a considerable factor in it. It may be said, however, that the collection apparently includes the original manuscripts of all Mr. Lockwood's articles on telephone history, and the notes from which he wrote the articles, so that much of detailed information about the history of the Telephone has thereby been preserved.

There are also a number of letters and documents of distinct historical value, which through the years have drifted into Mr. Lockwood's hands and been preserved, among them an original agreement of association, April 10, 1880, whereby Herrick P. Frost, George W. Coy, Charles E. Buell and Morris F. Tyler of New Haven proposed to develop telephone exchange service; letters and memoranda of Isaac D. Smith of the Capitol Drug Store, Hart-

ford, who put up one of the first of all telephone exchanges; and letters and statements of Thomas B. Doolittle in regard to his early experiences and services. There are also the original letters from H. W. Pope and Theodore N. Vail by which Mr. Lockwood was engaged in the summer of 1879 and began his distinguished career in the Bell System.

One of the valuable services the American Telephone Historical Collection can render is to preserve to future generations the individual quality and personality of the various leading telephone men whose papers it preserves. Any one who was acquainted with Mr. Lockwood at all, knew and enjoyed the fact of his strong individuality. The completeness of these papers renders his collection in a very real sense a lasting and authentic portrait of the man as he was, with his great abilities, his great eccentricities, his intense loyalties and his remarkable usefulness in the time of his chief service.

W. C. LANGDON.

Notes on Recent Occurrences

GENERAL DIRECTORY CONFERENCE

THE Second Bell System General Directory Conference was held in New York City during the week of January 16 to 21 and was attended by approximately fifty-five men. The Associated Companies were represented by their Directory Managers and, in some cases, by those in charge of directory production or the sale of directory advertising.

The general plan followed in the conference was that of presentations by the Associated Company representatives of prepared papers covering the various phases of directory work which were followed by general discussions. The major subjects discussed at this conference concerned directory service and directory advertising.

It was of particular significance that the majority of the conference time was spent on those topics which are of most importance in the rendering of a directory service, adequate and satisfactory from the user's standpoint. There was much valuable discussion of subscribers' directory needs and the scope of printed directories, the appearance of directories and ease of reference, production and delivery time and completeness of delivery, accuracy of information, maintenance of directories in good condition, directory service to toll users and directory printing.

Classified directories were discussed at some length and emphasis was placed on the thought that the value of such directories, both to the users and advertisers, is proportionate to the extent to which subscribers find them convenient and useful for reference purposes.

It was the opinion of the conference that greater use of educational publicity, both in the introductory pages of directories and in other forms is desirable in order to assist subscribers in making the most effective use of

their telephone directory as it is related to their telephone service in general.

During the week, the conference was addressed by Mr. W. S. Gifford, President, and Mr. B. Gherardi, Vice-President of the American Company, and Mr. J. W. Bancker, Vice-President of the Western Electric Company.

PRESIDENT GIFFORD IN THE MARCH "WORLD'S WORK"

THE March issue of the *World's Work* contains a number of brief answers to the question "Which Way, America?" by leaders in labor and industry, compiled by Frederick Palmer. Among these answers is one by President Walter S. Gifford which appears under the title, "Forward in the Conquest of Nature!" and is as follows:

"History records civilizations that have risen and fallen by the conquest of one people by another. To-day, in America, we are engaged in building up a civilization by conquering nature, not our fellow-man. We are fighting a battle between science and organization on the one hand, and the unknown forces of nature on the other. The opportunities for conquest are unlimited, and success is shared by every one.

"Great progress has already been made in the production of the material comforts of life with a decreasing amount of labor; but even now, in spite of what has already been achieved, it is safe to say that we have only begun to win the battle with nature. It is true that the spoils of victory are largely material, but they are not being won out of the exploitation of human beings. On the contrary, these spoils of victory will be available for exploitation by human beings for their own expansion. Literature, science, philosophy, and the high art of living are supported by the margin above the necessities of life. This margin is growing; leisure and

the opportunity for the development of the individual are steadily increasing.

"It is all so new that it is not surprising that we are at times bewildered as to whether this abundance may prove a blessing or a burden. Absence of economic want means, at least, opportunity for increased freedom for the individual.

"Even in the production of these material things, there is a new ideal, an ideal of service. This ideal is, I believe, more widespread and more significant than many people realize. Men of business and industry are more and more influenced by the idea of being of service to their fellow-men. They interpret their respective businesses in terms of service to the public. Andre Siegfried, in his book "America Comes of Age," calls this idea of service "the religion of America" and intimates that this religion cloaks much hypocrisy. True enough, but if the American public did not really believe in the idea, there would be no profit in assuming it. The idea is very general. Also, it is new, and of great significance. It is supplementing and, I believe, to some extent replacing the merely acquisitive motive that has previously been supposed exclusively to govern industrial affairs. When pessimists tell us that our civilization is too material it is well to ponder carefully the significance of this new but very real ideal of service.

"For the future, America would seem to hold out increasing material comforts for all, increasing leisure with its opportunity for individual freedom, and a new idealism making for sounder morals and higher standards."

WIDER RANGE, LONGER HOURS, LOWER RATES ON TRANSATLANTIC TELEPHONE SERVICE

WITHIN a short time after the transatlantic telephone circuit between the United States and Great Britain completed its first year of operation, the usefulness of the service was substantially increased by

successive extensions, which make possible communication by this route to several of the principal cities on the Continent of Europe. The hours of service were also lengthened and rates substantially reduced.

Belgium

On January 19th, the service was extended to afford communication between the United States and Cuba, and the cities of Brussels and Antwerp in Belgium. Belgium thus became the fifth foreign nation to be brought within speaking distance of the average American home; the first four countries being Canada, Cuba, Mexico and Great Britain.

Connection with Belgium's capital city and principal seaport, and with all other points on the Continent of Europe reached by the transatlantic telephone service, is made over the regular circuit which has been in operation for more than a year between the United States and Great Britain, supplemented by telephone cable connections to the Continent.

Canada—Britain

A week after the opening of service to Belgium the transatlantic telephone circuit was extended to afford communication between Quebec, Toronto, Montreal, Hamilton and Ottawa, Canada, and all of Great Britain. Previously these cities had transatlantic service to London only. On March 8th, the service was extended to Halifax, St. John, Winnipeg, Calgary and Vancouver. Calls between Canada and Great Britain pass through the United States using the same transatlantic radio circuit as calls between this country and England.

The Netherlands

The next extension in the scope of the transatlantic telephone service occurred on January 30th, when service was opened between all parts of the United States

and Cuba and the Dutch cities of Amsterdam, Rotterdam and The Hague. Calls between the United States and these cities in the Netherlands are transmitted by way of London and thence over land lines and a submarine cable under the North Sea, which establishes direct communication with Holland's capital city, The Hague, her principal financial center, Amsterdam, and her most important seaport, Rotterdam.

Germany

On February 10th, the German cities of Berlin, Hamburg and Frankfort-on-Main were added to the continental points which are brought within the scope of the transatlantic telephone service. Telephone communication between this country and Germany was formally opened by a conversation between Chancellor Marx and Under-Secretary Olds, acting Secretary of State in the absence of Secretary Kellogg. Chancellor Marx expressed his "sincere desire that this new means of communication will also contribute towards intensifying the amicable relations between Germany and the United States and toward furthering the reciprocal exchange of spiritual and material values." In reply, Secretary Olds expressed his gratification at the establishment of the new service and said that he was sure it would promote cordial relations and friendly understanding between the German and American peoples. Mr. Olds then spoke with Mr. Schurman, the American Ambassador at Berlin and Dr. von Prittwitz-Gaffron, the German Ambassador at Washington conversed with Herr Schaetzel, German Minister of Posts and Telegraphs.

Telephone connection between the United States and Hamburg and Berlin is effected by way of Rotterdam. Frankfort-on-Main is reached over the circuit connecting the United States with Brussels.

On March 19th the scope of the service was further extended to include the German cities of Bremen, Cologne, Dusseldorf and Mannheim.

Sweden

Still another country on the Continent of Europe was brought into voice-to-voice communication with the United States on February 20th when Stockholm, Sweden, was added to the cities reached by the transatlantic telephone service. The service to Stockholm was opened by Crown Prince Gustaf Adolf with a call from his residence in the Swedish capital to Secretary of State Kellogg in Washington.

Following this, congratulations were exchanged between Count Hamilton, Director General of the Swedish Telephone and Telegraph Department and President Walter S. Gifford. In the course of his remarks, Count Hamilton said: "I feel a desire to express to you as the President of the American Telephone and Telegraph Company, also to your staff, our admiration of the splendid technical achievement which has made it possible to establish this length of telephonic communication across the ocean over a distance of 8,000 kilometers. * * * I am convinced that the Swedish public will greatly appreciate the possibility now offered them to communicate with their business and private friends in your country not only by means of telegram but also by means of direct speech."

In reply, Mr. Gifford said in part: "On behalf of myself and my associates in the American Telephone and Telegraph Company, I thank you for your most generous reference to our accomplishments toward making possible telephone service across the Atlantic. It is of special pleasure and significance to us that we are now able to talk with Sweden and it is our hope and belief that this new service of communication will bring still closer together the peoples of your country and ours. It will make for a better understanding and an increased business and social intercourse."

Both Count Hamilton and Mr. Gifford referred to the former's visit to the United States last fall when,

while he was a delegate to the International Radiotelegraph Conference at Washington, he visited New York in company with other delegates and viewed some of the activities of the American Telephone and Telegraph Company, the New York Telephone Company and the Bell Telephone Laboratories.

On February 28th, transatlantic telephone service was further extended to afford communication between this country and Gothenburg, Sweden. The circuit was formally opened by conversations between Mayor Lindbergh of Gothenburg and Olof Herman Lamm, Swedish Consul General in New York and between President Carlander of the Gothenburg Chamber of Commerce and G. H. Lundbeck, President of the Swedish Chamber of Commerce in New York, who is also Managing Director of the Swedish-American Steamship Line.

Greetings were also exchanged between municipal officials and telephone executives of the two cities.

Calls between the United States and Sweden travel by way of Great Britain and the Netherlands and thence across Germany via Hamburg to Rostock. Here the circuit passes through a submarine telephone cable under the Baltic Sea to Malmo, in Sweden, whence land cables carry the calls to Stockholm in the Northeast and Gothenburg in the Northwest.

France

The formal opening of transatlantic telephone service connecting all points in the United States and Cuba with Paris, via the radio telephone circuit to England and thence by submarine telephone cable under the English Channel to Boulogne, took place on March 28. President Walter S. Gifford in New York spoke with M. Maurice Bokanowski, the French Minister of Commerce and Industry and with General John J. Pershing in Paris. Thereafter, General J. J. Carty exchanged greetings with M. H. Milon, Chief Engineer and Director of Telephones of the French Ministry of Posts and Telegraphs, and with

Colonel H. E. Shreeve, Technical Representative of the American Telephone and Telegraph Company in Europe. Several of the speakers recalled the experiments in transatlantic telephoning in 1915, when Colonel Shreeve was one of the American engineers listening, by permission of the French Government, at the Eiffel Tower, who heard the first words transmitted by radio telephone across the Atlantic. In concluding the ceremonies, Colonel Shreeve talked from Paris with Mr. B. B. Webb at New York, whose voice, sent out from the Naval Radio Station at Arlington, Virginia, spoke the first words heard across the ocean during those early experiments. Among those gathered about President Gifford and General Carty during the opening ceremonies were the following engineers who participated in the experiments which made possible the development of the transatlantic telephone service: E. H. Colpitts, H. D. Arnold, W. Wilson, H. A. Wilson, R. A. Heising, Lloyd Espenchied, John Mills, O. E. Buckley, O. B. Blackwell, A. M. Curtis, H. W. Everitt and B. W. Kendall. The cermonies were also transmitted through loud speakers to an audience gathered in an adjacent auditorium.

Conversations inaugurating the service were as follows: President Gifford, at New York, said to M. Maurice Bokanowski, Minister of Commerce and Industry for France, in Paris:

"YOUR EXCELLENCY: In opening for public service the transatlantic telephone circuit between France and the United States, it is but natural that we of the American Telephone and Telegraph Company should recall the debt of gratitude which we owe the French Government for its part in making possible the transmission of speech across the Atlantic.

"In 1915 France was defending herself valiantly in a bitter war. The United States had not yet entered the war.

"Yet, in the face of military requirements which taxed her resources to the uttermost, in the midst of war on an

unparalleled scale, in which communication facilities played a vital part, France permitted us a vital facility of communication—the Eiffel Tower. Night after night our engineers were given, for appointed periods, the use of this great tower for their experiments in transatlantic telephony. Our engineers set up their apparatus in the Eiffel Tower. Night after night they listened, but no words from America came to their waiting ears. And then, one night, words came—came from the United States Naval Radio Station at Arlington, Virginia, to the listening engineers in the Eiffel Tower. Telephoning across the Atlantic was experimentally successful. From those experiments has developed the regular telephone service between France and America which we open for public use today.

"It is fitting that I should use the transatlantic service to express our appreciation to you for the essential aid which the French Government gave us in making such a service possible, and I hope that bringing the two countries within talking distance may increase not only personal contacts over the telephone between peoples in the two countries but travel as well, for the deterrent to travel of being far from home is greatly lessened when the distance can be spanned by the human voice."

M. Maurice Bokanowski replied in French from Paris. His speech has been translated as follows:

"MR. PRESIDENT: I thank you sincerely for the kind words to France, which you have just pronounced upon the inauguration of the public telephone service between our two countries.

"It is a pleasure to me to recall the great place which the United States of America occupies in the history of telephony. Since the day when the human voice for the first time could be transmitted by means of a metal wire, no progress has been made in this field, in which American savants and engineers have not taken a part.

"Mr. President, you will here recall the day when your engineers in the heart of threatened France from the top

of the Eiffel Tower were able for the first time to hear a voice coming from America.

"I am happy to think with you that the progress accomplished since then, today permitting of opening this public service, will contribute to strengthen the ties of friendship which since the birth of the great American Republic have united it to the French Republic, and that this work, commenced in the midst of the war, will thus become one of the foundations for the maintenance of the World's peace.

"I beg you to express to your collaborators in the American Telephone and Telegraph Company and to all your compatriots, our admiration for the magnificent results which you have obtained, as well as the sympathetic feelings of the French Government and people."

President Gifford in New York then spoke as follows to General Pershing in Paris:

"I do not know whether it be appropriate to ask a man of action to open a service for talking, but I remember that the last time I talked to you in France—at that time both had to be there to talk together—there were occasions when quick personal contact with the United States would have been useful.

"Such contacts ought to be equally useful in time of peace, and what is equally important in this life, they ought to afford many people pleasure—as the chance to talk to you now does me. I greatly appreciate your joining us in opening this service to the public."

General Pershing answered from Paris:

"Thank you very much for the sentiments which you have just expressed. I remember very well the conversation to which you refer and I fully agree that if during that period of stress the transatlantic telephone had been available it would have been very useful. Without fear of contradiction I can also affirm that as an instrumentality of peace nothing is more effective than a voice-to-voice communication by telephone and I welcome this new link between nations of the world as a means of im-

proving social relationship and developing a common economic and social viewpoint. Permit me to congratulate you and the members of your staff for the important part you have contributed to this great achievement and to express the hope that technical developments will continue until the blessings of this most personal form of communication is made physically and economically available to men of all nations."

General Carty in New York then addressed M. H. Milon, Chief Engineer and Director of Telephones, Ministry of Posts and Telegraphs, in Paris:

"It gives me great pleasure that this latest marvel of the telephone art furnishes to me the opportunity of conversing with you again, and recalling my long-time friendship with you and your associates in the Department of Posts and Telegraphs.

"The establishment of this new transatlantic telephone service marks the successful culmination of those experiments begun more than twelve years ago, when the first words ever spoken across the Atlantic Ocean passed from the United States to France.

"Interrupted by the war, and delayed by the difficult conditions following the war, the scientific experiments were resumed, and what was formerly but a dream, today has become a reality. .

"It is a source of deep satisfaction to me to have the privilege of extending to you congratulations upon the inauguration of telephone service between the United States and France, and to send to you, and through you to your associates in the telephone service in your country, greetings and felicitations from your fellow-workers in America."

In reply M. Milon said in French:

"GENERAL: I am happy to be able, by a means which a few years ago seemed impossible of realization to renew the expression of the ties of a friendship which was formed nearly 20 years ago during a period when I still was almost a novice in the telephone service and you already the

most qualified representative of that brilliant group of engineers whose work has been and will continue to be the subject of the admiration of the entire world, and to which we owe, amongst other things, the brilliant achievement which we are today celebrating.

"I regret that General Ferrie, who would have been more qualified than I, on this occasion to represent the French technicians, at the present moment is away on a journey and so is unable to extend to you the same greetings as his colleagues and collaborators.

"I hope that the French and American engineers will not be among the last to profit from this marvellous means of communication which they have just created, and that the more intimate contact thus created will further strengthen their friendship already old, at the same time as it will render their cooperation more fruitful."

General Carty then said to Colonel H. E. Shreeve, Technical Representative in Europe of the American Telephone and Telegraph Company, in Paris:

"COLONEL SHREEVE: You are to be congratulated at your good fortune in being present today at Paris upon the formal opening of telephone service between the United States and France. It is most appropriate that you should participate on this occasion, and that you should be in Paris; for you were in that group at the Eiffel Tower in 1915, which heard the first words ever spoken across the Atlantic Ocean. The engineer whose voice you heard then, Mr. B. B. Webb, is with me now, and will speak to you again."

Colonel Shreeve, speaking from Paris, answered:

"To have taken part both in the first experiment and in the inauguration of commercial telephone service between the United States and France is indeed a great privilege. That General Ferrie is unable to be present is, I am sure, a great disappointment to all of us, as he contributed so largely in France to the success of our early experiments. I am glad to hear, however, that you have with you in New York the engineer who in 1915

spoke from the American side the first words across the Atlantic and shall be delighted if he will say a few words to me."

Greetings were then exchanged between Colonel Shreeve and Mr. B. B. Webb as follows:

Mr. Webb: "Good night, Shreeve. That may not seem reasonable at this time in the morning but I am repeating the first words you heard over the Atlantic in 1915."

Colonel Shreeve: "I am glad to hear them again and glad to hear you."

Mr. Webb: "Well, you answer quicker than you did then. It took twenty-four hours then for us to get word from you by cable. There are sixteen of the crowd that worked on the 1915 experiments here listening to you. They all send their regards. Good-bye."

Rates Reduced and Hours Lengthened

A reduction of $30 in the rate for a three minute transatlantic telephone call was made effective March 4, 1928. This amounts to a 40 per cent. reduction on the basic rate, New York to London, the new schedule between these two cities being $45 for three minutes and $15 for each succeeding minute. The three minute rate from New York to Belgian cities is now $48, to Dutch cities and to Paris $48.75, to Swedish cities $51.75, and to German cities $50.25.

Two hours have been added to the service period of the transatlantic telephone circuit, making the channel available from 7:30 A.M. to 8:00 P.M., Eastern Standard time. This corresponds to 12:30 P.M. to 1:00 A.M. in Great Britain. The extension of service hours indicates the increasing stability of the circuit as well as the growing demand. At the time of the opening of the commercial service last year a total of only 4½ hours of service daily was offered, which was later increased to 10½ hours.

It is now possible for American telephone users to

American Telephone and Telegraph Company officials at Midwinter Convention of the American Institute of Electrical Engineers. Bancroft Gherardi, President of the Institute at the microphone of the transatlantic telephone, by which British and Americans assembled in London and New York held a joint meeting, February 16, 1928

reach over 3,066,000 telephones on the other side of the Atlantic. Of these, 1,600,000 are in Great Britain, 100,000 in the Belgian cities of Brussels and Antwerp, 109,000 in the Dutch cities of Amsterdam, Rotterdam and The Hague, 800,000 in the German cities of Berlin, Frankfort, Hamburg, Cologne, Dusseldorf, Bremen and Mannheim, 147,000 in the Swedish cities of Stockholm and Gothenburg, and 310,000 in Paris, France.

In addition, American telephone users have access to 18,365,000 telephones in the United States, 1,280,000 in Canada, 75,000 in Cuba and 30,000 in Mexico. The grand total of telephones which can be reached is, therefore, in the neighborhood of 22,800,000.

TRANSATLANTIC TELEPHONE UNITES BRITISH AND AMERICAN ELECTRICAL ENGINEERS IN JOINT MEETING DURING MIDWINTER CONVENTION OF THE A. I. E. E.

THE sixteenth winter convention of the American Institute of Electrical Engineers was held in New York, February 13–17. Mr. Bancroft Gherardi, Vice-President and Chief Engineer of the American Telephone and Telegraph Company, President of the Institute, presided at the general sessions. Mr. H. P. Charlesworth, Plant Engineer of the same company and Chairman of the Meetings and Papers Committee, conducted several of the technical meetings.

A wide variety of technical papers were presented, among which were, "The Manufacture and Magnetic Properties of Compressed Powdered Permalloy," by W. J. Shackelton and I. G. Barber, and, "Certain Topics in Telegraph Transmission Theory," by H. Nyquist, all of the Bell System.

The session on interconnected power systems, held under the auspices of the Committee on Power Generation, and the communication session were particularly well attended.

assembled in London and New York held a joint meeting, February 16, 1928

One of the evening meetings was partially devoted to the presentation of the John Fritz Medal to General John J. Carty, Vice-President of the American Telephone and Telegraph Company, "for pioneer achievement in telephone engineering and in the development of scientific research in the telephone art." Mr. Gherardi, as President of the A. I. E. E., spoke of the distinguished achievements of General Carty and conferred upon him the academic title of "The Dean of Telephone Engineers." In accepting the award, Mr. Carty delivered an address "Ideals of the Engineer". Both addresses appear elsewhere in this issue of the BELL TELEPHONE QUARTERLY.

The meeting held under the auspices of the Committee on Communication included as its main feature a joint session of the Institute and the British Institution of Electrical Engineers in London by means of the transatlantic telephone. Prior to the joint meeting, the technical and operating features of this new achievement in communication were discussed in papers presented by Mr. O. B. Blackwell and Mr. K. W. Waterson of the American Telephone and Telegraph Company.

Scheduled to begin at 10:30 A.M., New York time, 3:30 P.M. in London, the joint meeting of the A. I. E. E. with the British Institution was opened promptly on the second. As the "zero hour" approached, Mr. Charlesworth prepared to open the joint meeting. He glanced at his watch and looked inquiringly at the engineer seated on the platform with a telephone close to his lips to give the word to those supervising the circuit's operation. The latter nodded affirmatively, and after a few preliminary remarks with Colonel Lee in London, Mr. Charlesworth turned the microphone over to Mr. Gherardi who thereupon requested Mr. Archibald Page, Chief Engineer of the Central Electricity Board in London to act as chairman of the joint meeting.

As the final word fell from his lips, a roar of applause came from the loud speakers overhead, giving evidence that the London section of the meeting had heard all distinctly.

Astonishingly clear and loud enough to be plainly audible in the farthest seats came Mr. Page's reply, gracefully accepting the chairmanship and requesting Mr. Gherardi, in turn, to address the meeting. There was little to choose between the amplified voices of the American speakers, reaching the audience through a cluster of horns above the stage, and the British accents emanating from the same horns.

The stressed significance of the meeting was reflected in the eloquent remarks of those who addressed the joint session, Mr. Gherardi, Dr. Jewett and General Carty in New York, and Mr. Archibald Page, Colonel Purves, Engineer-in-Chief of the British Post Office, and Sir Oliver Lodge in London.

That such a meeting was the culmination of plans cherished for many months was revealed in the remarks of Dr. F. B. Jewett, Vice-President of the American Telephone and Telegraph Company, and President of the Bell Telephone Laboratories.

"Colonel Purves and Mr. Gherardi will remember, and the rest of you will be interested to know, that in London, more than a year ago when we were engaged in final considerations preliminary to the opening of commercial transatlantic telephony, we discussed the details of just such a meeting as this. That our discussion should have been serious and not a pleasant mental diversion at a time when the channels of communication were not in operation is a striking evidence of the sound basis which underlies present-day electrical engineering. The fact that we saw and appraised the many obstacles to be overcome did not in the least diminish the assurance with which we talked of and planned for a distant event.

"While, therefore, the present occasion is highly gratifying to the engineers whose work had made it possible, it is in no sense a surprise.

"The success of this occasion is significant also in that it is the tangible evidence of a cooperation both intimate and full between men so situated as to make cooperation

difficult. On behalf of my associates in America, I salute our associates in England."

General Carty offered a resolution to be inscribed in the minutes of each society, expressing satisfaction at this new form of international assembly. Sir Oliver Lodge in London seconded the resolution and concluded his remarks as follows:

> "The union and permanent friendliness of all branches of the English-speaking race, now let us hope, more firmly established than ever, is an asset of incalculable value to the whole humanity. Let no words of hostility be ever spoken."

Calling for a vote on the resolution, Mr. Page, the Chairman, asked those in favor of the resolution to signify the same with the customary "Aye".

A silence followed, lasting for a fraction of a second. Then a deep chorus which had come from across the Atlantic boomed from the horn. The American audience immediately added its approval, mingling its voices with those from the Old World. A more striking testimony to the success of the demonstration would be hard to imagine.

Subsequent to the meeting, the Board of Directors of the American Institute of Electrical Engineers adopted the following resolution:

> *WHEREAS:* On February sixteenth, 1928, there was held a Joint Meeting of the British Institution of Electrical Engineers, its attending members and guests being assembled at twenty-eight Victoria Embankment, London, England, with the American Institute of Electrical Engineers, convened in the Engineering Auditorium, New York, U. S. A., during which all of the proceedings were rendered perfectly audible to both assemblies by means of land and trans-oceanic communication channels made available through the cooperation of the American Telephone

and Telegraph Company and the British Post Office; and

WHEREAS: This extraordinary demonstration, the first of its kind in history, was successfully accomplished only by the perfectly concerted efforts, not only of the American Telephone and Telegraph Company and the British Post Office, but also of all of the individuals concerned in its preparation; therefore it is

RESOLVED: That the Board of Directors of the American Institute of Electrical Engineers, on behalf of those members and guests whose privilege it was to attend the Joint Meeting, and also on behalf of the entire membership of the Institute, hereby expresses its thanks and its recognition of the efficiency, public spirit, and high technical achievement of these cooperating organizations as evidenced by this event; and especially extends its thanks and congratulations to the many technical assistants and workers without whose intelligent and faithful labors this proof of advance in applied science would have been impossible.

THE ANNUAL MEETING

At the annual meeting of the stockholders of the American Telephone and Telegraph Company, which was held at the headquarters building, 195 Broadway, New York, on March 29, the annual report was approved and the Directors were reelected. There were 7,167,746 shares voted or 64 per cent of the total.

Abstracts of Recent Technical Papers from Bell System Sources

Diffraction of Electrons by a Crystal of Nickel,[1] by C. J. Davisson and L. H. Germer. The scattering of electrons by nickel has been reported on recurrently since 1921. This paper gives the latest results which indicate that a wave length is in some way connected with the electron's behavior. A rather complete summary of the experiments and conclusions appeared in the Bell System Technical Journal for January, 1928, which makes unnecessary a fuller account here.

A Note on the Thermionic Work Function of Tungsten,[2] by C. J. Davisson and L. H. Germer. It has been pointed out that the authors in a previous paper [3] had neglected to apply a correction for the "Schottky Effect" to their results. The present note applies this correction which is found to be comparatively small and does not materially affect the results given before. A fuller discussion of the interpretation of the work function measurements previously reported is also included in this note.

The Action of Fluxes in Soft Soldering and a New Class of Fluxes for Soft Soldering,[4] by R. S. Dean and R. V. Wilson. This is a report of basic studies of soldering fluxes undertaken by the authors. It was found that the fluxing action depends on the evolution at soldering temperatures of HCl gas or other halogen acid gases which have been found to be effective soldering fluxes. Based on this discovery soldering fluxes have been found among the organic compounds and the way opened for the development of a truly non-corrosive flux.

Experiments and Observations Concerning the Ionized Regions of the Atmosphere,[5] by R. A. Heising. Experi-

[1] Phys. Rev., Vol. 30, No. 6, pp. 705–740, December, 1927.
[2] Phys. Rev. Vol. 30, pp. 634–638, November, 1927.
[3] Davisson and Germer, Phys. Rev., Vol. 20, p. 300 (1922).
[4] Indus. & Eng. Chemistry, Vol. 19, No. 12, pp. 1312–1314.
[5] Proc. I. R. E., Vol. 16, pp. 75–99, January, 1928.

ments are described in which a virtual height of the reflecting ionized region was measured using time lag between radio signals arriving over a direct and the reflected path. Heights were found of 150 to 400 miles with vertical movements at rates as high as 20 miles per minute. Other experiments and curves are mentioned which show absorption to be one of the important factors causing poor daylight transmission for wave lengths around 214 meters. A discussion is given to show that both electromagnetic waves from the sun and β particles must be assumed to produce ionization to explain radio transmission phenomena observed.

The ionization is pictured as beginning at an altitude of about 16 miles and extending upward, and as experiencing diurnal and seasonal variations. The electromagnetic or day ionization occupies a wide region, and is fairly steady except for the diurnal variation. The β particle ionization which is the principal ionization at night occurs continuously. It is, however, less dense than the other ionization and is very variable.

Certain Topics in Telegraph Transmission Theory,[6] by H. Nyquist. The author gives results of theoretical studies of telegraph systems which have been made from time to time. Among other things he points out that although the usual method of determining the distortion of telegraph signals is to calculate the transients of the system an alternative method is based on the steady state characteristics. For the first method the telegraph wave is taken as a function of t and for the second as a function of ω. A discussion of the minimum frequency range required for transmission at a given signaling speed is also included in the paper.

Plane Waves of Light. II. Reflection and Refraction,[7] by Thornton C. Fry. This paper extends the study of plane light waves, which was begun in the Journal of

[6] Presented, A. I. E. E., February 13–17, 1928.
A. I. E. E. Jour., Vol. XLVII, No. 3, pp. 214–216, March, 1928.

[7] Journal of the Optical Society of America, Vol. 16, pp. 1–25, January, 1928.

the Optical Society for September, 1927, to the phenomena of reflection and refraction. It develops the general formulae for reflection from a plane boundary between two media and for reflection from thin films, paying especial attention to the situations under which "hybrid" polarization occurs. The differences between the reflected and refracted components in the case of dielectrics and metals are illustrated by a number of diagrams.

The paper closes with a discussion of the determination of the optical constants of metals, both from the state of polarization of the reflected light and from the direction of emergence of the ray transmitted through a prism.

A General Operational Analysis,[8] by W. O. Pennell. The paper outlines the elements of a general operational analysis. Using p as the symbol for an operator, the author, starting with a general typical defining equation such as $p\ (ax.^{b})=\psi(a,\ x,\ b)$, proceeds by definitions and theorems to demonstrate the use of operational methods to a large variety of common mathematical operations.

Propagation Characteristics of Sound Tubes and Acoustic Filters,[9] by W. P. Mason. This paper describes a method for making acoustic propagation measurements, and presents the results of attenuation and velocity measurements of straight tubes and acoustic filters. The ordinary electrical transmission measuring circuit is employed in conjunction with loud speakers, and acoustic resistance terminations. The process of measurement consists in obtaining the transmission characteristics of the systems with the device to be measured in the acoustic circuit, then obtaining the characteristics with the device to be measured taken out of the acoustic circuit. The difference between these two measurements gives the transmission characteristics of the device to be measured, between the two acoustic resistance terminations.

[8] Jl. of Math. & Phys. of M. I. T., Vol. 7, No. 1, pp. 24–38, November, 1927.
[9] Physical Review, Vol. 31, No. 2, pp. 283–295, February, 1928.

Results obtained from these measurements for straight pipes agree well with the Helmholtz-Kirchoff Law.

Precision Determination of Frequency,[10] by J. W. Horton and W. A. Marrison. The relations between frequency and time are such that it is desirable to refer them to a common standard. Reference standards, both of time and of frequency, are characterized by the requirement that their rates shall be so constant that the total number of variations executed in a time of known duration may be taken as a measure of the rate over shorter intervals of time. Frequency standards have the further requirement that the form of their variations and the order of magnitude of their rates shall be suitable for comparison with the waves used in electrical communication.

Two different types of standard which meet these requirements are described. One consists of a regenerative vacuum-tube circuit, the frequency of which is determined by the mechanical properties of a tuning fork. The other is a regenerative circuit controlled by a piezo-active crystal. Means are provided, in the case of each standard whereby the recurrent cycles may be counted by a mechanism having the form of a clock, the rate of which is a measure of the frequency of the reference standard.

Data taken over a period of several years with a fork-controlled circuit show that, under normal conditions, its rate may be relied upon to two parts in one million. Data taken over a much shorter time with crystal controlled oscillators indicate that they are about ten times as stable.

Brittleness Tests for Rubber and Gutta-Percha Compounds,[11] by G. T. Kohman and R. L. Peek, Jr. An insulating material compounded of rubber, gutta-percha, or of similar substances becomes brittle at a temperature characteristic of the material, below which it may not

[10] Proceedings of the I. R. E., Vol. 16, No. 2, February, 1928.

[11] Ind. & Eng. Chem., Vol. 20, pp. 81–83, January, 1928.

be used if liable to mechanical stress. This paper describes an apparatus designed to determine this temperature by giving the sample a sharp bend through a fixed angle. The highest temperature at which fracture occurs in this test (the brittle temperature) is found to be nearly independent of the bending angle and the sample's dimensions provided the rate of bending is maintained at a nearly constant (high) rate. A modified form of the apparatus is also described with which the brittle temperature may be determined when the material is under high hydrostatic pressure. The constancy of the brittle temperature when determined under different conditions suggests that it marks a change in the structure of the material.

A Method of Rating Manufactured Product,[12] by H. F. Dodge. This paper outlines a method of rating manufactured product. In the particular form here described, the rate has been found very useful for measuring the quality of communication equipment and materials entering the plant of the Bell System. While the primary object is control of quality of finished product, it is proving useful for measuring the workmanship of individual operators and groups of operators engaged in similar production work. Particular attention is directed to the statistical aspects of the rate to show how it can assist in controlling quality.

Bridge for Measuring Small Time Intervals,[13] by J. Herman. A bridge circuit for measuring time intervals from about one ten-thousandths of a second up to several seconds is described and its operation explained. The device is fairly accurate and easy to operate and gives the results of measurements in fractions of a second directly. Its calibration can readily be determined mathematically since it is dependent only upon the values of certain capacitances and resistances used in the measuring circuit.

[12] Bell System Technical Journal, April, 1928.
[13] Bell System Technical Journal, April, 1928.

Precision Tool Making for the Manufacture of Telephone Apparatus,[14] by J. H. Kasley. This article outlines some of the refinements necessary in the art of tool making and makes clear the reasons for the high accuracy required by reference to commonly used parts made by the Western Electric Company. Due to restrictions of space the author limits his discussion mainly to punches and dies but indicates how similar refinements hold regarding jigs, screw machine tools, milling cutters, etc.

Methods of precision measuring are described, from the "Hoke" gage blocks which at 68° F. are accurate to a hundred thousandth of an inch to several methods where light is used to magnify variations that would not otherwise be detectable. Methods taking advantage of the interference of light waves permit determination to within a few millionths of an inch.

Transatlantic Telephony—Service and Operating Features,[15] by K. W. Waterson. This paper describes some of the differences in operating practice on the two sides of the Atlantic and plans which were worked out for taking account of them in the handling of commercial transoceanic calls. Differences in language is also another problem which has required solution. Data are included giving an idea as to the extent to which the transatlantic connection was used during its first year, there having been established during this time a total of something over 2,300 connections.

Transatlantic Telephony—The Technical Problem,[16] by O. B. Blackwell. This paper describes in rather non-technical terms the engineering problems involved in developing the transatlantic radio trunk by means of which the American telephone system of some 18,000,000 stations can communicate with the English telephone system of about 1,500,000 telephones, and also with the telephone systems of other European countries.

[14] Bell System Technical Journal, Vol. 7, No. 2, April, 1928.
[15] Bell System Technical Journal, April, 1928.
[16] Bell System Technical Journal, April, 1928.

Measurement of Capacitance in Terms of Resistance and Frequency,[17] by J. G. Ferguson and B. W. Bartlett. The adaptation of a bridge circuit due to M. Wien together with apparatus and procedure is described which permits measurement of capacitance in terms of resistance and frequency with an accuracy comparable to that of the primary standards. Among its advantages over the Maxwell method commonly employed are the use of a single frequency voltage and the facts that there is no general limitation placed on the type of condenser which may be measured or on the frequency at which the measurement may be made. The method is also applicable to the determination of inductance since its unit, like that of capacitance, may be derived from the units of resistance and frequency.

[17] Bell System Technical Journal, April, 1928.